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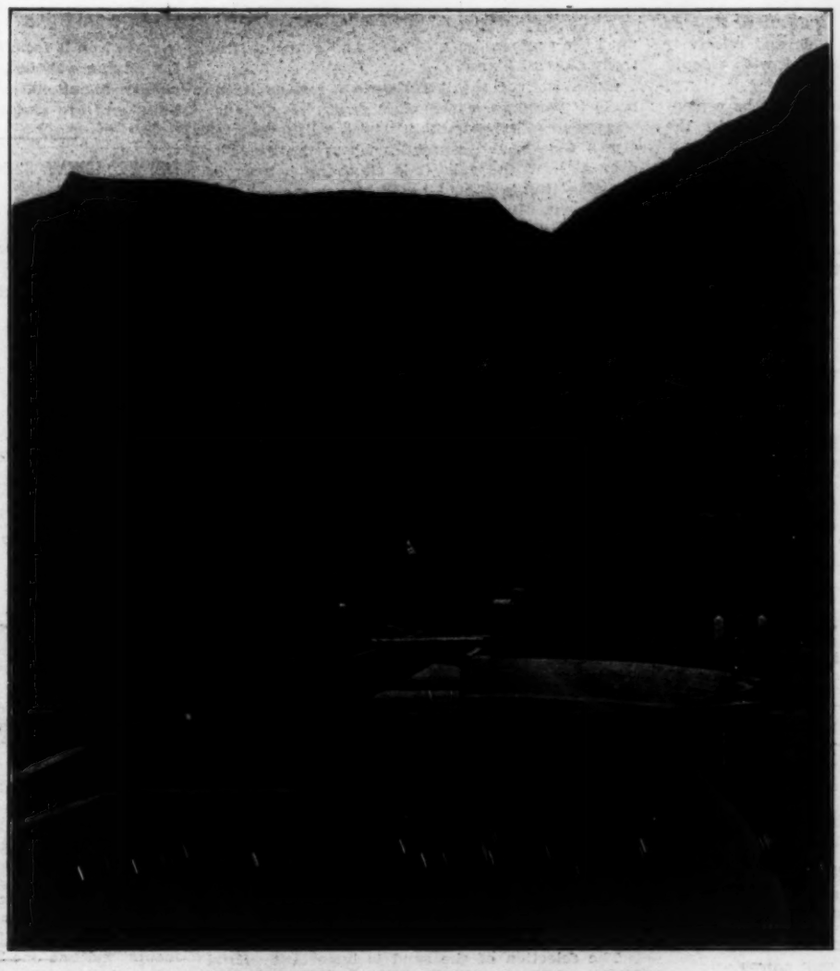
THE ANCIENT WATER-TANKS OF ADEN, ARABIA.

By Arthur Stanley Riggs.*

In making the trip from the West to the East, with India, China or the Philippines, as the objective, the traveling engineer meets with very little worth seeing, from a purely technical standpoint, between Gibraltar and the chunky little promontory of Arabia known as Aden, whose capital city, of the same name, is situated at the base of the Shum-Shum mountains on the floor of the crater of what was once an active volcano, but which has been extinct so long that even its name has been forgotten.

The name of the city and province of Aden is said to be derived either from the tribe of Ad, or else from the name, Ad, of the second and favorite son of the Arab who originally built the town. Of the city of Aden itself there is little to see, and that is bad. But scarcely a stone's throw beyond the old white, yellow and pale blue city, there rise in a gorge in the side of the old crater some of the most wonderful water reservoirs now existing in the world. To understand the location and peculiarities of the reservoirs or tanks, as they are commonly called, a brief description of the rocky promontory is necessary. The city of Aden lies at the bottom of the old crater, whose sides are entirely of grey and red and brown lavas, breccias and gypsum; the rocks are many of them schistose and some are spongy, but not a scrap of vegetation is to be seen anywhere on the sides of the frowning cliffs and crater walls, which rise in a sullen majesty of isolation and desolateness which is overpowering and appalling. All around the city, on top of the lava rim of the former smoking pit, are the fortifications, and they, too, are wonderful, as they travel for miles up the most impossible heights and plunge down into valleys so sheer and difficult as to seem defying to the constructor. These fortifications, the outer lines of which are older, if anything, than the tanks, include four huge iron gates in the mountain passes to protect the garrisons from native treachery. The gates are made of iron plates, about ¼-in. thick and are set in very massive masonry; the gates, of course, are modern. To the north of the almost perfect circle at the bottom of the pit, on a plateau whereon stands the city, is a deep cleft in the side wall of the crater, which was apparently an old lava channel or else the result of some cataclysmic eruption of the volcano. Here it was that the ancient engineer showed his mettle, and here the tanks were built which were to supply the city with water, as two or three wells afforded but scanty and brackish supplies.

Of the date of construction of the tanks, little is actually known, and the best authorities disagree as to the name of their builder as well. Some declare them to have been constructed by a Persian engineer during the second invasion of the Yemen territory, about the year 600 B. C., while others assign them to the time of one of the early Roman emperors. In any event, these huge reservoirs antedate the Christian era; and though the name of their designer and builder is lost, his wonderfully perfect work still endures.



THE ANCIENT WATER TANKS OF ADEN, ARABIA.

View looking up the gorge in which the tanks are located. The whole region is absolutely bare of vegetation. The scattered trees near the base of the cliffs have been planted since the British occupancy and are kept alive by water drawn from wells about 150 ft. in depth.

As will be seen by reference to the accompanying views, the tanks are pockets artificially made in the narrow gorge, and not one of them is like another. Originally there were about fifty of these tanks, but when the British captured Aden in 1839, they found the tanks all filled to the brim with rubbish and drift, while many had been destroyed by the towns-people who had battered out great sections of the magnificently quarried and hewn blocks whenever they wished to build a new house. The British engineers restored fourteen of these tanks at a cost of about $180,000, thus making the reservoirs again available for water storage so that about 30,000,000 imperial gallons could be cared for easily during the rainy season. They are still in use, though no great amount of water has been seen in them since 1888, when a flood poured through the town and did much damage.

It is in their structure, however, that the tanks are most interesting. The lava sides and bottom of the gorge or cleft in which they are built were most ingeniously covered or lined with cement of a most peculiar type. To-day it resembles old ivory when seen close by, and at a distance of, say, fifty yards, it appears translucent and very

*The Lorraine, Fifth Ave. and 45th St., New York City.

soft, reminding one in its appearance to a certain extent of the little plaster-of-paris figures hawked here on the streets. As a matter of fact, however, this cement has stood the test of time and the elements wonderfully. The few places where it has cracked and been mended by the British engineers with Portland cement, show dull grey and cold against the warm color of the ancient Persian's plaster. Beginning far up the gorge, the tanks run down to the flat level of the crater bottom proper, each reservoir increasing in dimensions and capacity until the monster tank at the foot is reached, with a holding capacity of over 4,645,275 imperial gallons. The smallest of the restored tanks in this gorge holds 135,919, and the largest of the upper tanks, 1,255,424 imperial gallons.

The rock being rough and very solid, without any vegetation to absorb the water, dykes were run out at salient angles diagonally down the side of the wall of the gorge, covered with the cement just mentioned, and little courses formed into small aqueducts, so that when the rain falls, the water running down the hillsides meets these dykes, is turned by them, and flows into the natural pockets below, which have been so contrived that every natural advantage of the rock formation is utilized for storage. The tanks themselves are formed by masonry angles, some of them salient and others re-entrant, each hollow or jutting spur on the walls of the gorge being fitted with its opposite in the way of a dyke, dam or wall, so that the combination of natural and artificial blend into a wonderful and beautifully harmonized series of huge stone pots or caldrons, some of them being about 80 ft. deep and very narrow, and others wide and relatively shoal, though the writer saw no tank with a depth of less than about 20 ft.

It is interesting to note, also, that the cement used by the Persian contractor who built the tanks has puzzled the British engineers of modern times, and they have sent specimens of it, so I have been informed, all over the world, in the hope that some analyst can solve the problem and rediscover the secret of making a compound which will last indefinitely, be of a happy color and yet remain soft enough to permit one to scratch an inscription into it with a blunt point, for it is those characteristics which have made the Aden tanks' cement what it is now, when 2,500 years old.

VIEW OF INTERIOR OF THE TANKS, LOOKING TOWARD CITY OF ADEN AND THE SEA.

SAND-CLAY ROADS IN THE SOUTH.

The Office of Public Road Inquiries, in the U. S. Department of Agriculture, has issued in pamphlet form the report of Special Agent W. L. Spoon upon Building Sand-Clay Roads in Southern States.

In many sections of the country sand and clay are the only road materials available, and these have been used with success in some sections. A study of the good sand-clay roads shows that the essentials to success are puddling and saturating. The clay must be made homogeneous by adding water until it is plastic like dough; and to this plastic clay sand must be added to the point of saturation—but not beyond. Rolling is an essential to bring the sand grains into contact on all sides; and the rolling must be done as this mixture dries. This forces the particles of sand together, and any excess of clay rises to the surface, and requires more sand until the surface becomes hard and compact, free from clay-stickiness.

Sand-clay roads fail for various reasons. Imperfect drainage is the first cause. It is customary to give roads of this type a little greater crown than usual, especially where the grade is over 3%. If the subsoil is clay, the bottom of the side-ditches should be 18 ins. or more below the crown. But if the land is rolling and the subsoil is sand to a considerable depth, there is natural drainage and little or no side-ditching is required. Avoid, if possible, places where there are wet-weather springs; it is much better to change the line of the road to dry ground than to attempt to drain such places. If water is always present use sand alone, as this is better than sand and clay in such places.

Another cause of failure is the want of thorough mixing of even the proper proportions of sand and clay. Clay in lumps is utterly useless. The clay should be uniformly saturated with sand to a depth of 10 ins. When ridges and holes appear, level down the high places and add more sand, as a rule. In northern sections frost is a destructive agent on these roads, or temporarily so at least. In such cases the mixture must extend below the frost-line if the foundation is clay.

The selection of the sand is important. Sand made up of angular grains is alone adapted to sand-clay road-making; without such sand a perfect bond is impossible. In brief—the sand should be sharp and clean, and have a large grain rather than fine. Ferruginous clays are the best, and chalky clays the worst for road-making. Patience and perseverance are demanded for success; and the lack of these essentials account for more bad roads than any other cause. The building of a good sand-clay road is a process, not an instantaneous operation.

In many sections of the South, where sand largely predominates, the only clay found is sedimentary, often carrying much fine sand and hardly any iron. It is difficult to build a first-class road with these materials; but the first step toward success is a roadbed at least 20 ins. above standing water in the ditches. And the coarser the sand then used the better the road.

The report gives examples of good sand-clay roads. The Garner's Ferry Road, in Richland Co., S. C., has been in use for five years under the heaviest travel without any repairs. This road was originally in deep sand. It is 32 ft. wide. This and other roads of like good character were made of sedimentary clay with very ordinary cementing qualities. These roads more than double the hauling capacity of the truckers using them. As explained by the builder of the Garner's Ferry Road, the road was graded and the clay spread evenly over the surface to depth of 4 to 6 ins., depending on the percentage of sand in the clay. If the foundation is clay the sand is spread on it from 6 to 8 ins. deep. In this case the mixing was done by the travel itself. In this county about 400 miles of sand-clay roads are built, and are giving perfect satisfaction.

THE BROADWAY BASCULE BRIDGE AT MILWAUKEE, WIS.

By John Geist.*

The Broadway drawbridge in the city of Milwaukee, designed by the writer and recently completed, is a bascule lift bridge, which presents in design and construction several novel features. It is a deck bridge with the roadway 14 ft. above water level; it is 240 ft. long between end abutments, and has one 36-ft. roadway and two 10-ft. sidewalks. The central (movable) portion of the bridge consists of two equal leaves hinged at the outer ends. The span of 128 ft. 2 ins. center to center of trunnions affords a clear waterway of 100 ft. between fenders. The two side spans or approaches, which are always stationary are so designed that they serve to balance not only the

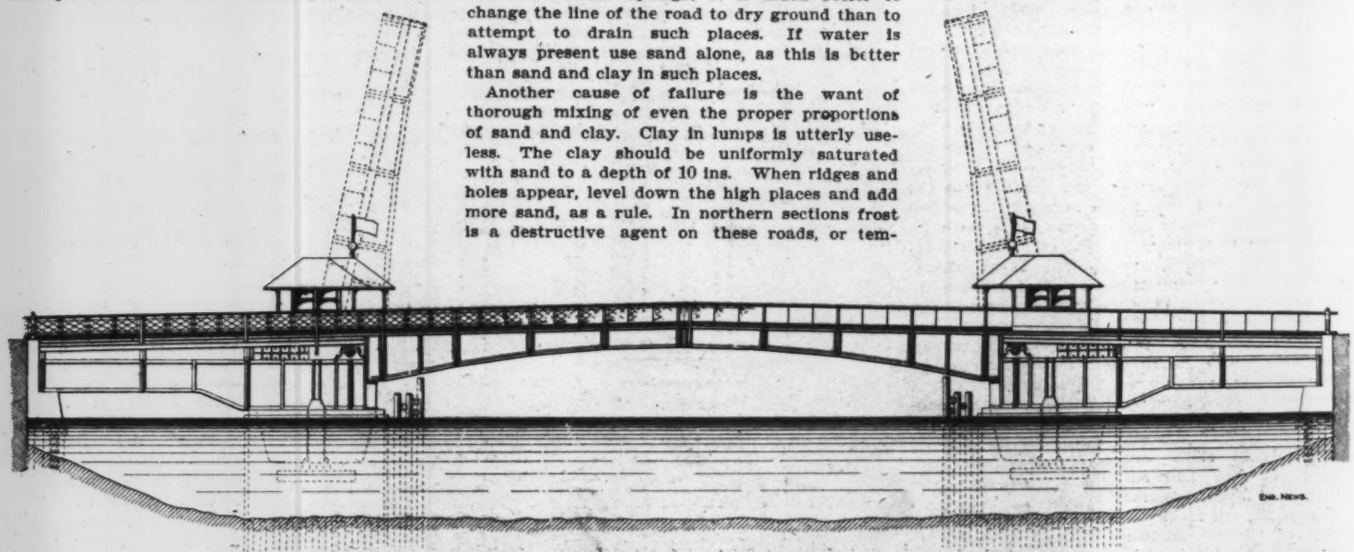


FIG. 1. SIDE ELEVATION, BROADWAY BASCULE BRIDGE, MILWAUKEE, WIS.

*Consulting Engineer, 52 Exchange Bldg., Milwaukee, Wis.

whole deadweight of the swinging leaves, but also any liveload which may come on these.

As may be seen from the drawings reproduced herewith, the approach girders are arranged in pairs and rest with one end on the abutments while their other ends are supported by steel main columns inside the river piers in such a manner that they form 6½ ft. long cantilevers to which the trunnions of the swinging portions are fixed. The main swinging girders are single-web girders, whose extensions back of the trunnions carry the necessary counterweights. They swing centrally between the pairs of approach girders (and also between the two main columns) into pockets in the river piers. These piers are of concrete supported by piles. Each pair of approach girders is rigidly connected together at their overhanging ends by a curved strut 4 ft. deep built of angles and plates. At each panel point back of the trunnions the two approach girders, which are spaced 7 ft. 3 ins. apart on centers, are connected by transverse diaphragms or girders having central plates on top on which the transverse floorbeams carrying the stringers and approach floor rest. By this arrangement the whole deadweight of the approach is equally transferred to the approach girders. These diaphragms are of plate-girder construction, except the one next to the trunnion. This frame is open-webbed, so that the tail end of the bascule girders can catch under its upper flange, abutting against an oak bumping block bolted thereto (see Fig. 2). It will therefore be clear that should any live load come on the leaves the deadweight of the approach spans must counterbalance it.

In order to give the necessary weight to the approach spans, heavy concrete arches with expanded metal reinforcement were used instead of the common buckleplate construction. The roadway of the approaches is paved with Trinidad asphalt and the sidewalks have a granolithic finish. The roadway of the movable portion is covered with a lower layer of 4-in. surfaced yellow pine planks laid diagonally with 1-in. openings, and with an upper layer of 3-in. white oak planks laid close and at right angles to bridge. The sidewalk floor is of 2-in. surfaced white pine planks laid with ¼-in. openings at right angles to bridge. The planks are well spiked to nailing strips bolted to the longitudinal stringers which in turn are supported by floorbeams and cantilevers riveted to the main girders.

Where the trunnion-shafts pass through the webs of the main girders, the latter are reinforced with steel plates and steel castings. The trunnion-shafts which are forged steel, are 25 ins. in diameter at the center and have 16 × 16-in. journals which rest in phosphor bronze bushings in cast steel bearings. The bearing pressure is about 800 lbs. per sq. in. Lubrication is effected through four channels radiating from a central hole in the end of the trunnion to which oil is fed from an oil cup fixed to the shaft.

The counterweight, about 125 tons for each girder, is of cast-iron blocks in four layers, two layers on each side of girder web. The two inner layers are directly bolted to the girder webs with two 1¼-in. horizontal bolts to each block; each of the blocks of the outer layers is recessed to fit a projection on the inner block and is fastened to the latter by two 1¼-in. vertical pins with head on top, these pins being simply dropped in place.

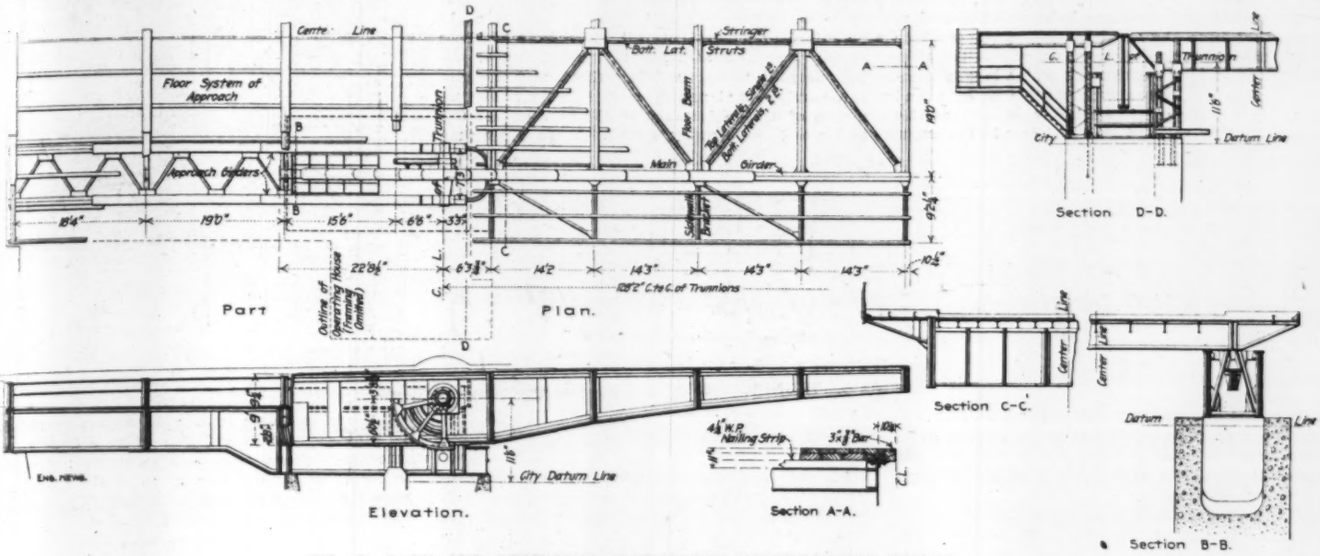


FIG. 2. PLAN AND SECTIONAL ELEVATIONS OF BROADWAY BRIDGE.

This is shown by the accompanying drawing of typical section. By this arrangement the difficulty of using very large, long bolts was overcome.

Each trunnion-shaft carries an operating sector, placed next to the roadway (inner side of the swinging girder). The sector consisting of an angle and plate framework with cast steel hub and rack. This sector is fastened to the girder web with 1-in. turned bolts. The racks of the two sectors for each leaf engage pinions of trains of gear wheels (one train for each sector) placed underneath the floor of approach spans on steel machinery girders and anchored to concrete piers.

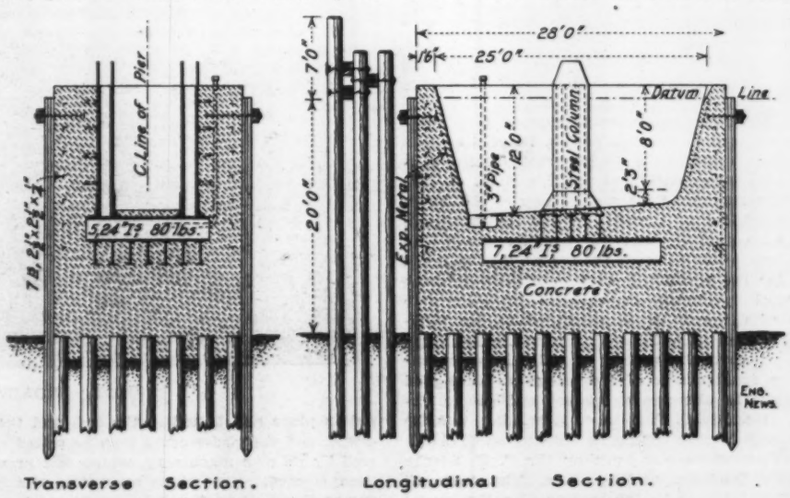


FIG. 3. SECTIONS OF A MAIN PIER, BROADWAY BRIDGE.

The two trains of gears are connected by a transverse shaft driven by a 500-volt General Electric motor of 500-HP., running at 110 r. p. m. With this machinery each leaf, weighing 400 tons, can be raised or lowered in about 20 seconds without jar. The transverse motor-shaft is also coupled by miter gear wheels (which can be thrown in or out of gear by a lever) to a vertical shaft connecting it with gearwork for handpower so that each leaf can be operated by two men with a 10-ft. lever in 15 to 20 minutes.

The break in the roadway and sidewalk floor at the junction of the stationary and movable portions of the bridge is about 3 ft. in front of the trunnions. In operating the bridge the floor of the lifting leaf rises and moves towards the approach and thus forms a strong continuous barrier. When it is considered that this bridge is opened sometimes as often as 150 times a day, this feature must be appreciated as a valuable guard against accidents. It also prevents water, dirt and snow from being deposited on the machinery below as is the case when the break in the floor is back of the trunnions; this makes it easier to keep the bridge clean and in good order.

As the main girders are placed entirely under the floor, a slot in the sidewalk floor was necessary into which they could pass when the bridge is opened for navigation; this slot is closed by a contrivance which is very effective and somewhat novel. Directly above the trunnions a light curved frame, slightly narrower than the slot, was fastened to the top flange of the main girders. This frame, whose covered top surface is concentric with the trunnion, projects through the slot in the sidewalk floor. Expanded metal was wired to this frame and the outside of the hollow box thus formed was plastered with Portland cement mortar and was given a granolithic finish the same as the sidewalks of approaches. By this arrangement the bulky and unsightly iron boxes generally used in trunnion bridges were dispensed with and a neater and less projecting construction secured.

The center lock consists of one 6 x 1¾-in. steel bar for each girder of one leaf, set transverse to the bridge and engaging slots at the ends of the girders of the other leaf. The locks are actuated from the operating house by a system of levers and shafts. The joint in the locking gear, between the portion fixed to the approach and that fixed to the bascule leaf, is made in a transverse throw rod located in front of the trunnion and shown in Fig 7; the "movable" part of this rod has a head adapted to lift out of a socket in the "fixed" part.

The operating houses are built on steel girders projecting from the approach spans. From here the hand-brakes are operated as well as the electric power and light equipment which is very complete. Steel stairways with gaspipe railings lead to the machinery platforms below, which are also surrounded by railings and so located that every part of the machinery is easily accessible for oiling and inspection. The pits are also completely surrounded by steel work except in the rear, and therefore accidents are guarded against without additional expense.

The principal feature of this design is the freedom from unequal loadings and absence of uplift on the river pier foundations. The main columns placed in the center of the piers rest on steel grillage and transmit their loads uniformly over the piling, about 10 tons per pile. In other bascule bridges an anchor column, placed as near the rear end of the pier as possible, is generally used to take the uplift caused by loads on the leaves; the main bearings of the bridge are placed at the front end of the pier and as far away from this anchor column as possible. The front piles of the pier are then subjected to a very high concentrated pressure aggravated by the uplift at rear end, from which results a very unequal and variable loading, with consequent unequal settlement and cross strains on the masonry. The effect of this is to bring the ends of the two leaves closer together than intended so that the meeting ends of the floor have to be adzed off to give sufficient clearance for the operation of bridge. This action was observed by the writer several years ago in case of a rather high lift-bridge shortly after its opening for traffic.

The Broadway bridge was designed for a uniform live load of 100 lbs. per sq. ft. of floor surface and in addition a double track electric railway with cars concentrating 57,000 lbs. on two four-wheel trucks. Each main girder of the leaves was calculated as a cantilever for the maximum loads without considering any transference of load from leaf to leaf through the locks. The material used for the structural work was medium steel. The working stresses corresponded practically to those of Cooper's latest specifications for highway bridges. Mr. Chas. J. Poetsch, City Engineer, prepared the general specifications governing the construction of the bridge and designed the concrete abutments, fenders and protection-work. Mr. Adolph F. Bues, of Milwaukee, was the contractor for the structure, which cost $125,375. The substructure was built by the C. H. Starke Dredge & Dock Co., of Milwaukee. The steelwork was manufactured by the Modern Steel Structural Co., of Waukesha, Wis., and inspected by R. W. Hunt & Co., of Chicago.

The erection of the bridge was in charge of Mr. John Ramsey, who very successfully carried out the writer's idea of rolling the bascule girders in place. Each girder (87 ft. long and weighing 34 tons) was unloaded from the cars at a nearby dock and placed on board of a large scow in a vertical position, well blocked up and braced, its tail end projecting about 12 ft. over the front end of the scow. The other end of the girder was suspended by tackles from a gantry placed near the rear end of the scow on rollers running on two longitudinal timbers on the deck. The loaded scow was then towed to the bridge site and swung in proper position, in front of the pier and across the river channel, by means of guy ropes fastened to scow and to fenders. On top of the approach girders heavy longitudinal timbers were placed forming a runway for a carriage made of blocking supported on rollers. From this carriage heavy double chains were hung on transverse timbers resting on jackscrews so they could be raised or lowered at will. The ends of these chains were now attached to the tail end of the bascule girder directly below them, and the girder, carriage and gantry were rolled forward by means of a rope fastened to the rear end of the girder and operated by a crab. When the center of the opening for the trunnion in the girder was directly over the center of the trunnion bearings, the trunnion-shaft with the hub of the gear-sector placed on it was suspended from a 10-ton derrick (used in the erection of the approaches) and put through the opening in the girder and forced into place by repeated blows from a heavy timber. As the bearings had previously been put in place and adjusted, it was not difficult to lower the trunnion-shaft into them by the chain from which the tail end of girder was suspended.

The scow with gantry and the carriage were now freed from the girder and withdrawn, and the girder was balanced by adding about twenty counterweight blocks. It was then swung to the upright position by means of the 10-ton derrick. The framework of the gear-sector was thereafter put in place and bolted to the hub and the girder-web, and the girder could then be raised or lowered by its own machinery, which had previously been erected. The whole operation was carried out at times when few boats were passing; sufficient channel-width was left for smaller craft such as tug boats. Attaching the counterweight-sections to the girder occupied the longest time, as these were made of the cheapest grade of cast iron, very rough and not true to pattern. With a derrick strong enough to swing the unbalanced girder into upright position the interruption to river traffic should not be over, say, one hour and a half at the most.

This method of erecting the four bascule girders should under favorable conditions be more economical and much quicker than erecting each girder in two pieces and splicing it in the field, requiring the fitting on and riveting of many long flange and web plates. It was very satisfactory to find that in spite of the long distance between the trunnions the overlapping ends of the bascule girders came perfectly in line and that the very small side play between bearing plates at the latch as originally provided was found sufficient.

This design of bascule bridge should be well suited for locations with wide waterway requiring long approaches and also where a deck structure for various reasons is preferred; and the writer presents this description to the profession hoping that it may lead to further developments and simplification of bascule bridges.

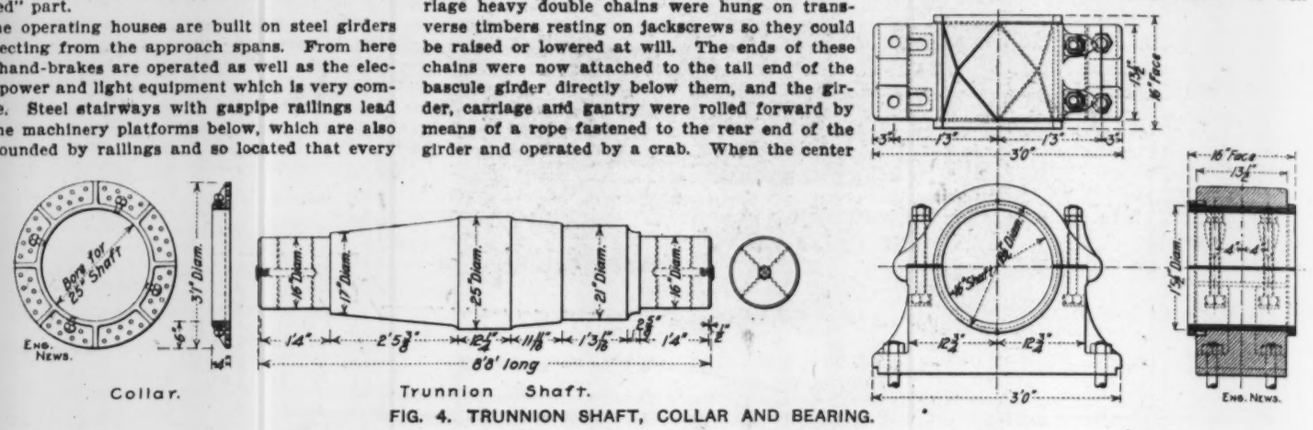


FIG. 4. TRUNNION SHAFT, COLLAR AND BEARING.

A SIMPLE SAND WASHER.

By F. H. Stephenson.*

There is now nearing completion at Yonkers, N. Y., a sand filtration plant with a filter area of one acre. The plant was designed by Mr. Allen Hazen, M. Am. Soc. C. E., and is being built by contract under his supervision by the firm of Tucker & Vinton. The filtering materials required are 1,500 cu. yds. of gravel and 5,000 cu. yds. of sand. That part of the specifications relating to the sizes of the sand grains reads as follows:

FIG. 5. BROADWAY BRIDGE, PARTLY OPEN.

> The effective size shall not be less than 0.25 millimeter nor more than 0.35 millimeter. The uniformity coefficient shall not be more than 3.0. The sand shall be free from dust and shall not contain more than 1% finer than 0.13 millimeter, and shall be entirely free from particles over 5 millimeters in diameter.

The sand pits near the work were examined and tested, but all carried too large a percentage of material finer than 0.13 millimeter. To enable the contractors to use the local sands, Mr. Hazen designed an apparatus to wash out the excess of fine material.

The apparatus (which is shown in the accom-

*Resident Engineer for Filters, Yonkers Water-Works.

FIG. 6. VIEW OF JUNCTION OF MOVING AND STATIONARY PORTIONS, SHOWING CONCRETE KNUCKLE OVER TRUNNION.

parying sketches) consists of a wooden box with inside dimensions of 10 ft. by 2½ ft. by 2½ ft. In one end is a 6-in. pipe, out of which lead three 3-in. pipes capped at the ends, which extend nearly the length of the box. In the bottom of the 3-in. pipes are ½-in. holes spaced 6 ins. apart c. to c. Outside the box on the 6-in. pipe line is a controlling gate. The 6-in. line is connected to a convenient water supply. At the opposite end of the box from the 6-in. pipe is bored a 3-in. hole. A sliding wooden door allows this hole to be open or closed at will. Three overflow or waste troughs are provided.

The method of operation is as follows: The gate on the 6-in. line is opened and the box filled with water. Sand, with the particles over 5 millimeters in diameter removed by screens, enters the box at the end, A. The upward currents of water from the holes in the 3-in. pipes tend to keep the sand in a state of suspension and water overflowing into the waste troughs carries with it finer particles of sand which it is desired to get rid of. When the box is partly filled with sand the sliding door at the end, B, is opened and the heavier and coarser sand flows out, to be gathered up and placed in the filters. The operation is then continuous so long as a steady supply of sand is fed to the washer. By manipulating the door at the end, B, the sand can be made to flow out with a very small percentage of water.

The results obtained have been very satisfactory. Sand from three pits has been used. The unwashed sand carried from 2% to 7% of material finer than 0.13 millimeter. The average was about 4½%. The sands after washing averaged 0.6% of fine material, as above described, which is within the requirements of the specifications. In a 10-hour working day this apparatus has several times washed 200 cu. yds. of sand.

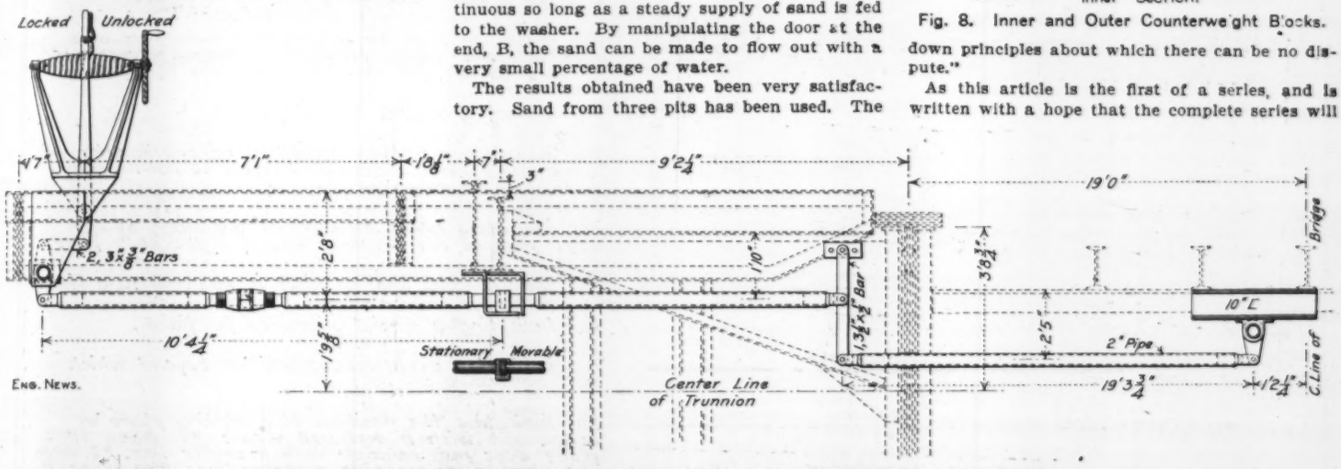
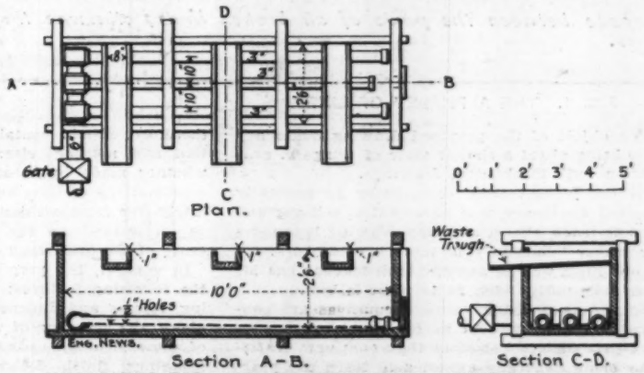


FIG. 7. TRANSVERSE SECTION NEAR TRUNNION, SHOWING JOINT IN LOCK RODS.



APPARATUS FOR WASHING BANK SAND; YONKERS, N. Y., FILTER PLANT.
Designed by Allen Hazen, M. Am. Soc. C. E.

A PROPOSED UNIVERSAL DICTIONARY OF MECHANICAL DRAWING.*

By George H. Follows.†

Part I. Introduction and an Alphabet.

Some two thousand four hundred years ago a philosopher and historian known to the world as Diogenes of Apollonia, said: "It appears to me that he who begins a treatise ought to lay down principles about which there can be no dispute."

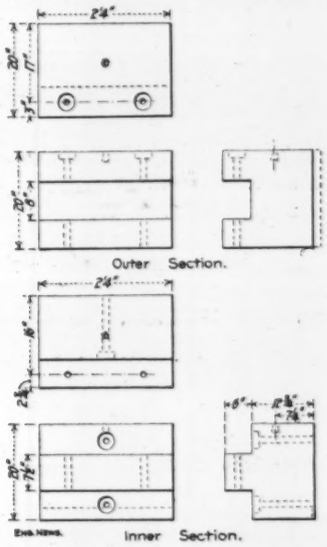


Fig. 8. Inner and Outer Counterweight Blocks.

As this article is the first of a series, and is written with a hope that the complete series will result in an acceptable "drawing dictionary" for general use, it seems only right to begin by laying down the principles upon which the character of the dictionary is to depend. I do not presume to think that the principles are new or that I am able to lay them down in such a way as to leave no room for dispute; but, believing that the manner of presenting a subject is fully as important as the subject itself, it seems best to begin in this way so that those who read the series critically may stand on common ground and, looking at each feature from the same general position, pool their ideas to some useful purpose.

Mechanical drawing is a "language"

This is the first principle that I would lay down, and it is the general one upon which arguments will be based and in keeping with which criticisms should be made; it means that mechanical drawing can be compared with any other language, English, for instance; for although it cannot be spoken or heard, it can be both written and read, written well and read well, written badly and read badly. And, just as the ability to write or read (that is, understand) good

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English depends upon a knowledge of English as a language, so the ability to make or read a good drawing depends upon a knowledge of drawing as a language.

When we think of English as a language, we have in mind an alphabet, words, and sentences; and going further to the written language as we find it in our libraries, we add chapters and books

There is a broad and useful analogy between mechanical drawing as a language and English as a language.

This is the second principle that I would lay down. There are many ways of expressing the analogy, but the following is sufficiently suggestive and will suffice for the present:

Lines are analogous to	Letters
Views	Words
Projected views	Sentences
Drawings	Chapters
Sets of drawings	Books

general uniformity about the mechanical features of all real books. By mechanical features I mean the type, the page numbering, the division into chapters, the insertion of illustrations, the position and general arrangement of title page, the index to contents, and the "build" of the book itself. So that when we compare two English books, even though they are by different authors and were printed in different countries, we find the same alphabet, the same spelling, sentences of similar form, the same rules of composition followed, and in general the same mechanical features, both inside and out. The advantage of this uniformity is twofold: The reader can turn from one book to another without being confused by differences in spelling, word meanings or general arrangement; and books can be placed side by side on the same shelf without offending our sense of what is reasonable.

compile one that will be valuable at the outset, that will be improved and become much more valuable in time, that will from the first enable the school or college course better to prepare a man for actual work in the modern drafting room, and that many drafting rooms will be only too glad to adopt.

The third principle that I would like to see accepted is in the nature of a definition:

Mechanical drawing is a language of lines, views, projected views, groups of views, signs and abbreviations, notes and explanatory matter, all for the positive conveying of exact information.

The reader should particularly note the clause, "all for the positive conveying of exact information." A shop drawing is intended not as an expression of opinion to be *argued* about, but as a set of instructions to be *obeyed*. A drawing,

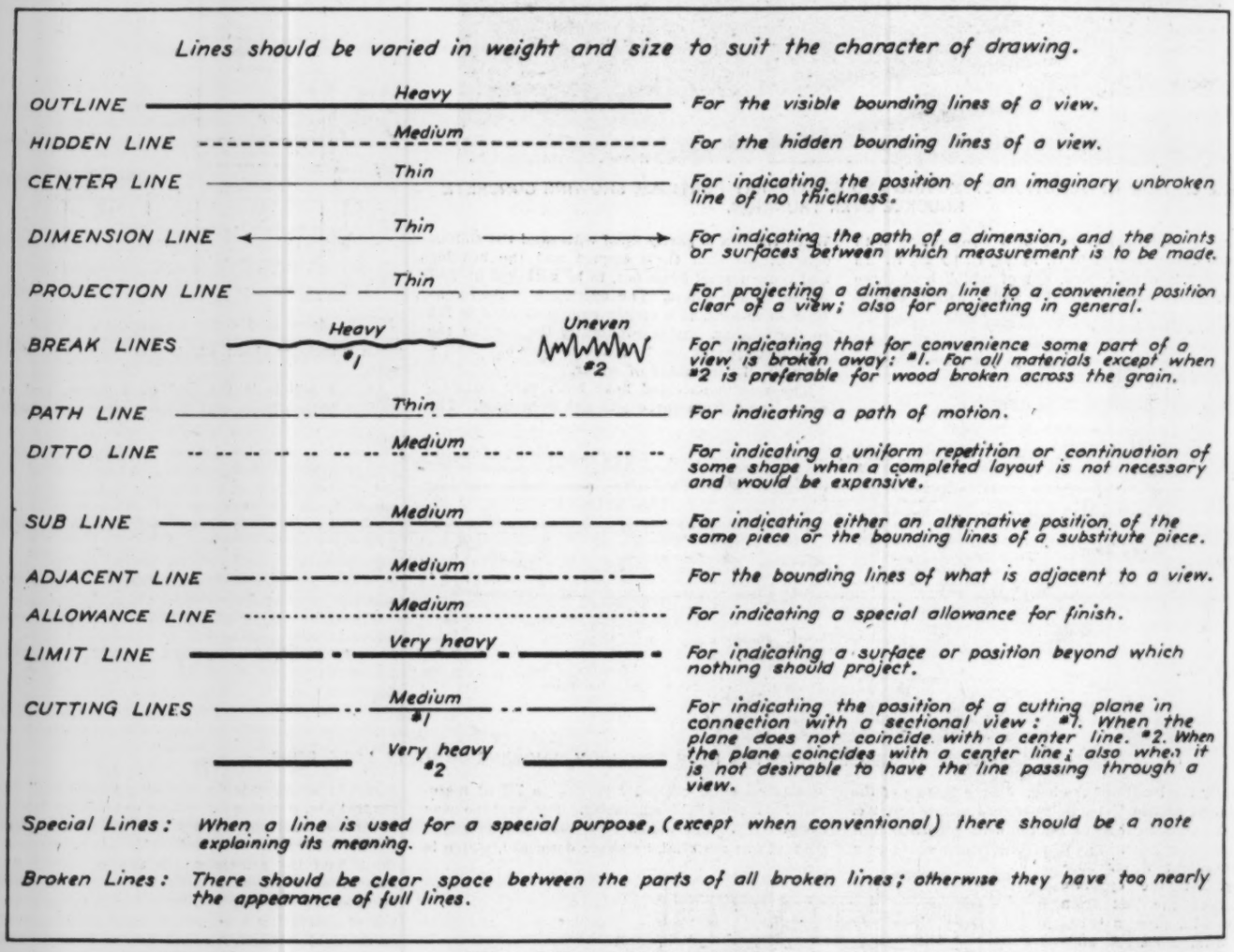

Lines should be varied in weight and size to suit the character of drawing.
OUTLINE
Heavy
For the visible bounding lines of a view.
HIDDEN LINE
Medium
For the hidden bounding lines of a view.
CENTER LINE
Thin
For indicating the position of an imaginary unbroken line of no thickness.
DIMENSION LINE
Thin
For indicating the path of a dimension, and the points or surfaces between which measurement is to be made.
PROJECTION LINE
Thin
For projecting a dimension line to a convenient position clear of a view; also for projecting in general.
BREAK LINES
Heavy
#1
Uneven
#2
For indicating that for convenience some part of a view is broken away: #1. For all materials except when #2 is preferable for wood broken across the grain.
PATH LINE
Thin
For indicating a path of motion.
DITTO LINE
Medium
For indicating a uniform repetition or continuation of some shape when a completed layout is not necessary and would be expensive.
SUB LINE
Medium
For indicating either an alternative position of the same piece or the bounding lines of a substitute piece.
ADJACENT LINE
Medium
For the bounding lines of what is adjacent to a view.
ALLOWANCE LINE
Medium
For indicating a special allowance for finish.
LIMIT LINE
Very heavy
For indicating a surface or position beyond which nothing should project.
CUTTING LINES
Medium
#1
Very heavy
#2
For indicating the position of a cutting plane in connection with a sectional view: #1. When the plane does not coincide with a center line. #2. When the plane coincides with a center line; also when it is not desirable to have the line passing through a view.
Special Lines: When a line is used for a special purpose, (except when conventional) there should be a note explaining its meaning.
Broken Lines: There should be clear space between the parts of all broken lines; otherwise they have too nearly the appearance of full lines.

FIG. 1. THE ALPHABET OF LINES.

Teachers and students alike should make practical use of this principle, as inducing a true conception of the relative values of the parts of drawings, and as enabling the subject as a language to be studied and taught intelligently.

Knowledge of English is obtained from books written with the express purpose of teaching it as a language, beginning with an alphabet of letters and the spelling of words, and ending with the teachings of scholars and thinkers from whose writings we receive instruction regarding the construction of sentences and the arrangement of ideas, as from the late Herbert Spencer's "Philosophy of Style."

So far as English is concerned, the result of having an accepted dictionary and the carefully written teachings of scholars is that books written by one man can be read and understood without difficulty by other men, and that there is

The object of the proposed drawing dictionary is to bring about a similar state of things in connection with mechanical drawings.

At the present time, there being no generally adopted dictionary, our universities, colleges and schools teach almost as many drawing languages (or rather "dialects") as there are teachers: for in one little way or another each teacher has his own independent idea as to what is best.

So far as drafting rooms themselves are concerned, it goes without saying that each has its own pet "dialect," or more than one; new draftsmen being generally expected to learn the practice of a "room" by observing existing drawings and doing likewise.

On all accounts it seems that there is a real need for a Universal Drawing Dictionary, and though any attempt to make the first one perfect and complete would fail, I believe it is possible to

therefore, should contain all necessary information and nothing else: and every statement, whether made by means of lines or words, or combinations of lines and words, should be absolutely free from ambiguity and as clear and easy to understand as the knowledge and common sense of the draftsman can make it.

In general, the proposed dictionary will cover the following features: Lines, letters and lettering, figures and dimensions, views and projected views, the grouping of views, sectioning, methods of dimensioning, conventional signs and their meanings, finish designations and marks, conventional methods (the draftsman's idioms), some suggestions regarding designations and abbreviations of names, lists on drawings, and a few example drawings with marginal notes.

No attempt will be made to have the dictionary cover shop systems, because to be universal in

character it must be good for any method of conducting business, just as the English dictionary is good for any method of handling a subject.

In this article a proposed alphabet of lines is presented. In presenting this and other features of the dictionary, I shall endeavor to state what the requirements are, to give all necessary definitions and by argument to show that what is proposed is reasonable.

Fig. 1 names, illustrates and defines the lines, while Fig. 2 is supplementary to the definitions given in Fig. 1 and is somewhat in the nature of an example drawing in which all the lines are used.

The requirements of the alphabet are:

1. That it shall be complete.
2. That the names of the lines shall be short and that they shall, as far as possible, indicate their use.
3. That the character of the lines shall be such that they can be readily distinguished one from another.
4. That the lines that are to be used the most shall show the greatest contrast, and be the easiest to draw.

The lines shown in Fig. 1 are designed as a "set" for pen work, to give satisfactory contrast, and are all drawn to the same scale; it is thus their *relative values* that are indicated, not a series of lines for mechanical copying. It is no more possible to have one weight and size of line suitable for all drawings than it is to have one kind and size of type suitable for all books. If this set of lines were reduced or enlarged by photography the same proportions and contrasts would be maintained. This indicates how the lines are to be used: No matter what the scale of a drawing there should be the same contrasts. In pencil work the contrasts will necessarily be less striking, but they can be maintained to a considerable degree when desirable.

THE OUTLINE:—There is really no room for argument about this line, except with regard to varying its thickness to give the effect of shading.

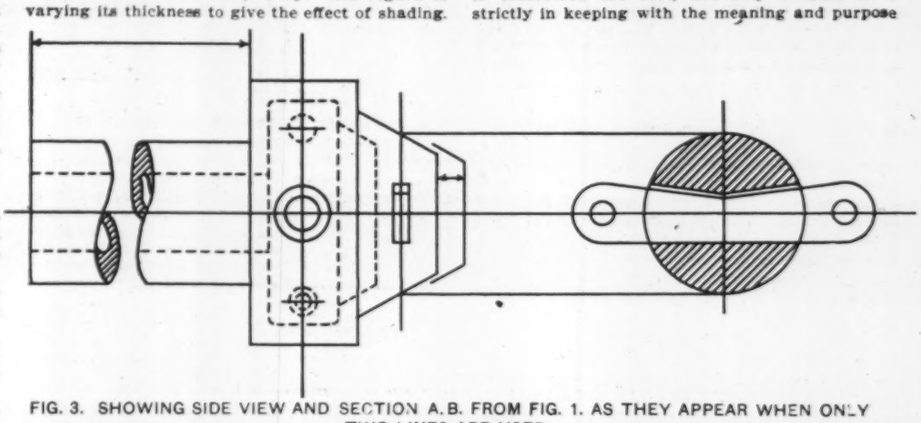


FIG. 3. SHOWING SIDE VIEW AND SECTION A.B. FROM FIG. 1. AS THEY APPEAR WHEN ONLY TWO LINES ARE USED.

Such shading lends some appearance of solidity to a view, but being expensive, it is very little used now in the drafting rooms of manufacturing concerns. However, the fact that it is used sometimes, as in government drafting rooms, where cost is not so closely figured, in patent office drawings, and for certain classes of illustrating, makes it best always to include it in a course of study. The ability to shade drawings is not only valuable in itself, but the study of it affords excellent practice in the use of drawing instruments.

THE HIDDEN LINE:—The illustration and definition do not require any special comment, this being the form already in general use.

THE CENTER LINE:—The unbroken, thin line is considered the best, not only because it is strictly in keeping with the meaning and purpose of the line, but because being the line from which principal dimensions are laid off, and in which centers are located, it *must* be accurate; and no other line can be drawn as accurately. The same line may be used for any imaginary line that is to answer the same general purpose as a center line; pitch lines for instance.

THE DIMENSION AND PROJECTION LINES:—In mechanical drawings, unnecessary intersections of lines should be avoided; this helps to clearness, and is one reason for having the di-

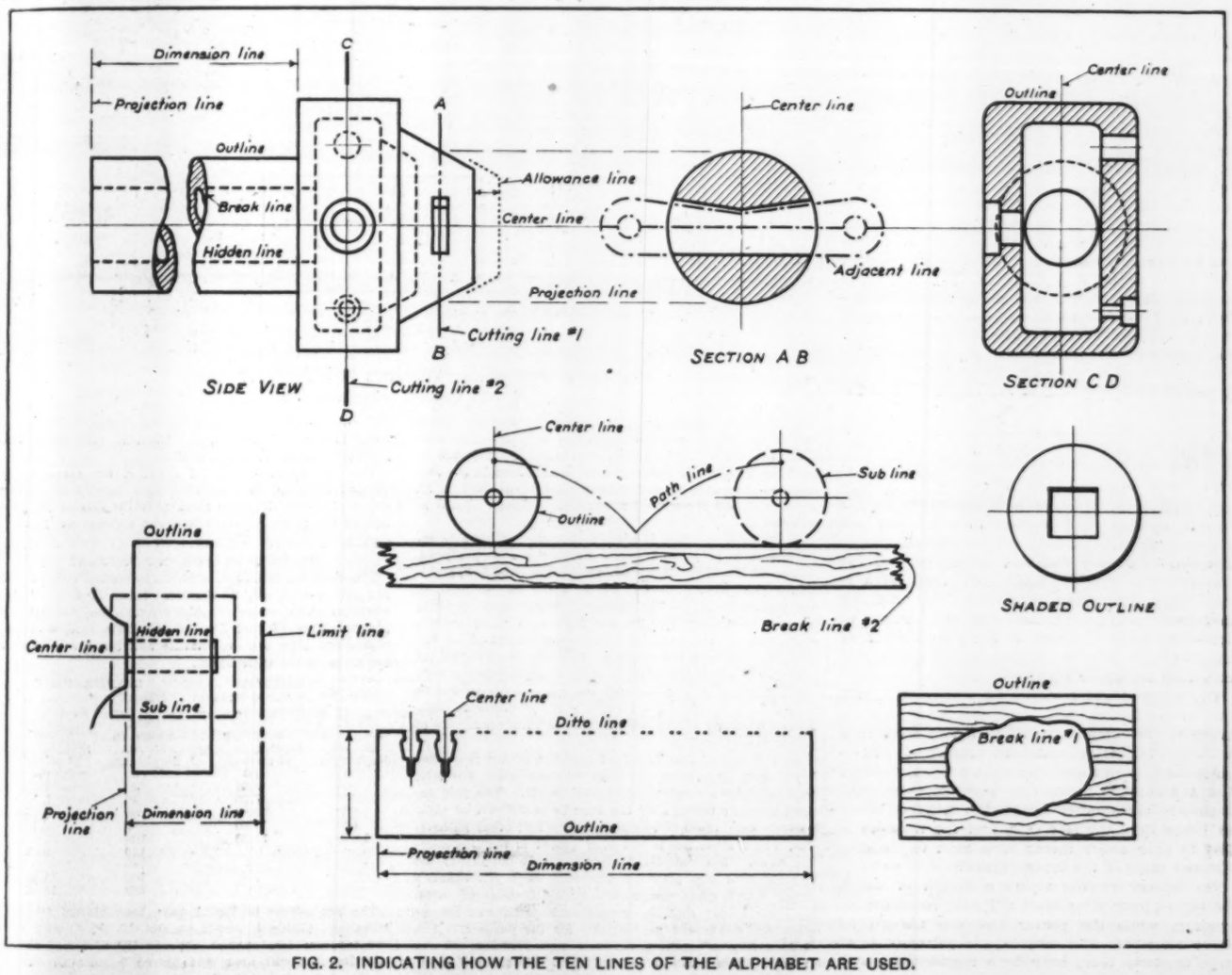


FIG. 2. INDICATING HOW THE TEN LINES OF THE ALPHABET ARE USED.

mension and projection lines broken, so that they may cross one another without actually intersecting. A projection line should never quite touch a bounding line; bounding lines stand out much more clearly if they are not interfered with.

The other lines do not call for any individual comment; they are all used in Fig. 2, where the lines of each view are named. In the Section AB and the side view belonging to it, ten of the fifteen lines are used. By way of contrast and with the idea of showing how very necessary it is to have an alphabet of lines, these same two views are repeated in Fig. 3, but with only two lines instead of the ten. The value of this alphabet of lines, like that of the dictionary itself, is more closely associated with the reading of drawings and the making of tracings than with the original work of the draftsman proper. An original pencil drawing bears somewhat the same relation to the tracing and blueprint made from it as an author's manuscript does to the printed book. In both cases the original is the work of one man and is not intended for the eyes of the public, while the result is to a large extent a mechanical product, and is for the reading of an unlimited number of men. And just as the duty of a publisher is to put the author's manuscript into such book form that the public may read with ease what the author has written, so it is the duty of the tracer to put the draftsman's work into such shape that others may easily read and understand it.

But although as directly affecting work done, the dictionary is more especially for the tracer and the "reader," the draftsman, too, must be minutely familiar with it, not only because a large part of his work is the reading of drawings, but because he must by notes or otherwise on his original drawings, however rough they may be, insure against misunderstandings on the part of the tracer.

The broad purpose of the dictionary, and of the alphabet of lines as part of it, is to make it easier for all concerned to read tracings and shop prints, and thus to save time every time a drawing is referred to. This is the immediate practical gain to be looked for from the general adoption of a drawing dictionary. There is also a gain of another and no less important kind: Mechanical drawing will cease to be something to "pick up," like bicycle riding, and will take its proper place as a universal language to be systematically studied; so that whether it is the draftsman that draws or the someone else that reads, there will be as little chance as possible for the misinterpretation or partial understanding of something that ought to be as plain as day.

NEW DESIGNS FOR STEEL FREIGHT CARS.

The steel car construction shown in the accompanying illustrations is designed to enable cars to be built and repaired in ordinary car shops, using only plates and commercial shapes that can be readily obtained in any part of the country. The special feature of the design is that, while the system of trussing the sills and underframe is followed, the truss members are of structural shapes, riveted to the sills, instead of being adjustable as in the usual arrangement of truss rods set up by turnbuckles.

The upper drawing shows an underframe with four steel channel sills, and two steel channel struts or transoms. Over the sill is a steel deck or floor. The truss members consist of angles under the side sills and a channel under the center sills, the channel passing up between these sills, as shown. In another design, the center sills are set lower than the side sills, and the transom is bent to pass under them; here, also, two angles take the place of the truss channel.

The lower drawing shows a design in which the plate-girder sides form the sills, requiring no trussing, while the center sills are trussed as above described. For deep hopper-bottom cars of large capacity there may be a transverse trussing by means of a bent angle, having its ends riveted to the floor and cross pieces, while the middle portion passes under the center sills, just back of the transom. This arrangement is also shown.

These designs have been made and patented by Mr. R. W. Oswald, of the Carlin Machinery & Supply Co., Allegheny, Pa., and arrangements have been made for the manufacture of some steel frame tank cars on this system. Mr. Oswald designed the steel frame cars for the Imperial Chinese Railways, which were illustrated in our issue of Aug. 31, 1899.

EXPERIMENTS ON GRAIN PRESSURES IN DEEP BINS AND THE STRENGTH OF WOODEN BINS.*

By Henry T. Bovey,† M. Inst. C. E.

The experiments about to be described were undertaken at the request of the Board of Harbor Commissioners of the City of Montreal, in connection with designs for a grain elevator, which had been prepared by Mr. J. A. Jamieson. These designs were submitted to the Minister of Public Works, the Hon. Mr. Tarte, who, on the advice of a committee of experts—Messrs. Vautelet, Roy and St. Laurent—condemned them for various reasons.

Amongst these reasons was the following:

That the pressure induced by the grain is similar in character and amount to that produced by a fluid of the same density as the grain, and that the grain in motion produces far greater stresses than the grain at rest, so that the material of which it was proposed to construct the elevator was not of sufficient strength.

That is to say, it was asserted by the committee of experts that the strength of the elevator in question was not nearly sufficient to bear the stresses which would be induced in the metal of the bin-walls, on the assumption that the pressure of the grain is similar to that which would be produced by a fluid of the same density as the grain. It is evident therefore that the experts were, at all events at the time they gave this decision, believers in the fluid pressure theory. The statement that on such a theory the metal would be subjected to a stress of more than 100,000 lbs. per sq. in. was naturally sufficient to lead the Minister of Public Works to acquiesce in the recommendation that such a danger must be avoided at all risks, and that therefore Mr. Jamieson's design should be rejected.

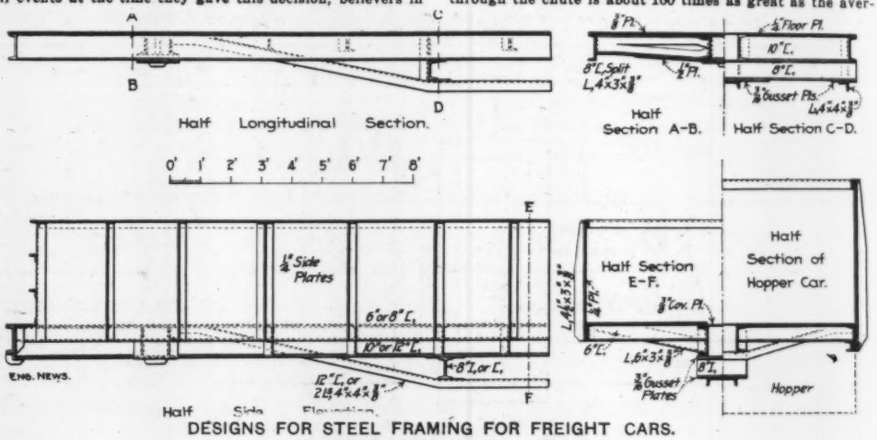
So far as it has been possible to discover, all reliable experiments to go prove that no pressure is ever produced, either on the sides or bottom of the bin, which approximates even closely to that which would be produced on the hypothesis of the fluid theory. It therefore seems to be a most serious position for anyone to make such a statement as to the excessive stresses produced on an hypothesis which is not based on fact, seeing that, as for example it did in the present case, it might cause a very large financial loss to an engineer who, so far as can be judged by men who have made a study of elevators, submitted a design of one which fulfilled both conditions of safety and suitability.

As a matter of fact, the fluid pressure theory is neither based upon experience nor upon common sense, nor is it warranted by a single experimental result. The only results brought forward by the experts in support of their position were those of Janssen, Prante and other authorities, whose experiments had been quoted in the Engineering News. But even these experiments do not justify the hypothesis of fluid pressure, especially as in Mr. Prante's paper, which gives the most complete account of them, he himself says that the apparatus he used was incomplete, too weak, and not suitable for the purpose. The impossibility of making accurate measurements of the effect of sudden jars or shocks, which this piece of apparatus was designed to do, may be estimated when it is considered that the measurement was practically similar to trying to determine the weight of a man by the effect produced by him in jumping on the platform of a scale. In concluding his paper, Mr. Prante honestly states, "For the present I must leave the reader to consider the preceding tests, insufficient as they are, as a first contribution which is to furnish an incentive to further and more accurate tests."

Perhaps, however, the most practical proof that the fluid pressure theory is altogether inapplicable, is the fact that thousands of elevators of the ordinary bin type, are in use on this Continent and have been so for many years, which could not possibly have supported the pressures induced on the fluid pressure theory.

Coming now to the tests which were carried out by myself, in company with Mr. John Kennedy,* I would premise the tables giving the results with a few words of explanation.

The plan adopted to measure the grain pressure was to utilize flat rubber diaphragms, connected by a rubber tube of small bore with mercury columns. These diaphragms were carefully calibrated both before and after the experiments. The pressures were observed both with the grain at rest and with the grain in motion, when the bin was filling and when it was emptying. The effects of suddenly closing the chute were also observed. It will be noticed that this latter effect is far less than one might have at first imagined. The reason for this should certainly have been at once apparent to the adherents of the fluid pressure theory, but it seems to have escaped them. Any additional pressure, due to the sudden closing of the chute, is that produced by the corresponding change of momentum. Although the grain runs with great rapidity through the chute, the average velocity of the grain in the bin proper is extremely small. Thus, for a 12-ft. × 14-ft. bin, with a 14-in. chute, the average velocity of the grain through the chute is about 160 times as great as the average velocity of the grain in the bin proper. Hence, the effort of suddenly closing the chute is very small, and, generally speaking, inappreciable.



DESIGNS FOR STEEL FRAMING FOR FREIGHT CARS.
R. W. Oswald, Allegheny, Pa.

The experiments as to the effect of the pressures developed by grain in deep bins were carried out on the Canadian Pacific Railroad elevator in the City of Montreal, and on the Great Northern Railroad elevator at Quebec.

SERIES I. TO IV., EXPERIMENTS AT THE C. P. RY. GRAIN ELEVATOR IN MONTREAL.

The bin used was 12 ft. × 14 ft., in section and the hopper gate was round, its diameter being 12 ins. In the whole of these series of observations, the pressure diaphragms used (B and C) were carefully calibrated both before and after the experiments and the average results are given in the table below:

DIAPHRAGM B. Effective sectional area = 109.36 sq. ins.		DIAPHRAGM C. Effective sectional area = 26 sq. ins.	
Dead weight in lbs. on diaphragm.	Corresponding reading in ins. of mercury.	Dead weight in lbs. on diaphragm.	Corresponding reading in ins. of mercury.
0	0.0	0	0.0
200	3.64	20	1.59
400	7.25	40	3.12
600	10.80	60	4.65
800	14.39	80	6.19
1,000	17.90	100	7.65
		120	9.02
		140	10.5
		160	11.95
		180	13.42

The two curves in Fig. 1 have been plotted from observations (Table I.) made on Oct. 21, 1901, with these two pressure diaphragms; the one (B) of 109.36 sq. ins. effective sectional area was placed horizontally at the center of the bin, while the other, (C) of 26 sq. ins. effective sectional area, was placed vertically in the side of the bin, in such a position that the maximum height of grain above the centers of the two diaphragms was 44 ft. 10 ins.

*From the discussion before the Canadian Society of Civil Engineers on the paper "Grain Pressures in Deep Bins," by Mr. J. A. Jamieson. Eng. News, March 10, 1904.

†Dean of the Faculty of Applied Science, McGill University, Montreal, P. Q.

*Chief Engineer to the Montreal Harbor Commissioners.

TABLE I.

Quantity of grain in bushels.	Diaphragm B, ins. of mercury.	Diaphragm C, ins. of mercury.
000	0.00	0.00
500	2.27	1.47
1,000	....	2.34
1,500	5.72	3.00
2,000	7.27	3.50
2,500	8.37	3.76
3,000	9.17	3.88
3,500	9.79	3.94
4,000	10.32	3.88
4,500	10.62	3.88
5,000	10.92	3.78
5,500	11.12	3.68
6,000	10.97	3.36

The hopper was, in the first place, filled to the top and carefully leveled across. Diaphragm (B) was laid on the grain at the center. Observations of the maximum pressures, in inches of mercury, were then made with the grain in motion and the effect of suddenly stopping the inflow, after each additional 500 bushels, was also observed; this sudden stoppage in no case produced any appreciable effect.

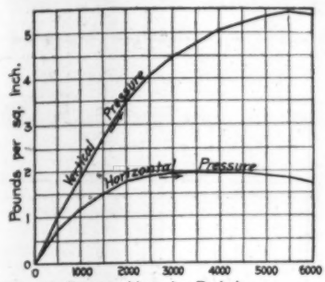


Fig. 1. Horizontal and Vertical Pressures at Bottom, Bin Filling.

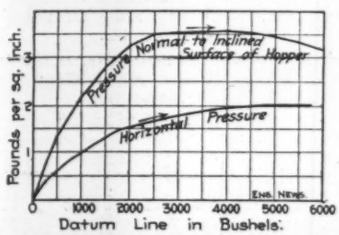


Fig. 3. Horizontal and Hopper Pressures at Bottom, Bin Filling.

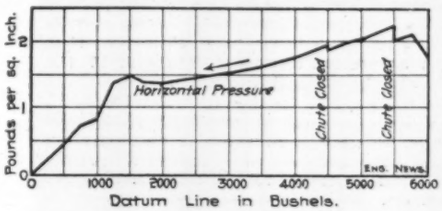


Fig. 2. Horizontal Pressure at Bottom, Bin Emptying.

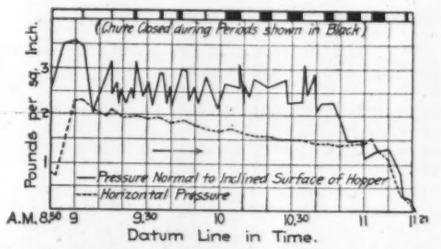

(Chute Closed during Periods shown in Black.)
Pounds per sq. Inch.
Pressure Normal to Inclined Surface of Hopper
Horizontal Pressure
Datum Line in Time.

Fig. 4. Horizontal and Hopper Pressures at Bottom, Bin Emptying.

Note: Chute is closed during intervals represented by black spaces.

FIGS. 1-4. GRAIN PRESSURE TESTS IN CANADIAN PACIFIC RY. ELEVATOR AT MONTREAL, OCTOBER, 1901.

The grain was then allowed to remain in the bin over night.

Thus, during the filling of the bin (Fig. 1) the maximum horizontal pressure on the bin wall

$$= \frac{26}{1}\left(40 + 20\,\frac{3.94 - 3.12}{4.65 - 3.12}\right) = 1.951 \text{ lbs. per sq. in.}$$

The maximum vertical pressure at center of bin

$$= \frac{200}{109.86}\left(3 + \frac{11.12 - 10.80}{14.30 - 10.80}\right) = 5.654$$

lbs. per sq. in.

SERIES II.—On Oct. 22, 1901, the bin which had been filled on the previous day was emptied. The diagram (Fig. 2), was plotted from observations taken at regular intervals of 1 min., as indicated in Table II. The effect of suddenly closing the chute, (1) after 500 bushels of grain had run through, and (2) after 1,500 bushels had run through, was also observed. On opening the chute, it was impossible to make any further observations with the central diaphragm as it immediately fell out of place with the grain.

Thus, while the bin was being emptied, the maximum horizontal pressure in lbs. per sq. in. on bin wall

$$= \frac{1}{26}\left(40 + 20\,\frac{4.32 - 3.12}{4.65 - 3.12}\right) = 2.142 \text{ lbs.}$$

per sq. in.

SERIES III.—The curves in Fig. 3 have been plotted from observations made with the two diaphragms, C remaining in the same position as before and B placed parallel to and half way down the slant of the hopper. The initial readings of B and C, in inches of mercury, when first in place, were 0.35 for B and 0.3 for C. The hopper was then filled up level with the top, the corresponding loads being 1.8 ins. of mercury for B and 0.32 in. for C. Observations of the maximum pressures in inches of mercury were then made with the grain in motion, and the effect of suddenly stopping the inflow, after each additional 500 bushels, was observed. This sudden stoppage in no case produced any appreciable effect.*

From the series of readings in this test, the maximum horizontal pressure on bin wall while the bin was being filled was,

$$= \frac{1}{26}\left(40 + 20\,\frac{4.05 - 3.12}{4.65 - 3.12}\right) = 2.006 \text{ lbs.}$$

per sq. in.

The maximum pressure in lbs. per sq. in. on the hopper bottom was

$$= \frac{200}{109.36}\left(1 + \frac{7.12 - 3.64}{7.25 - 3.64}\right) = 3.592 \text{ lbs.}$$

per sq. in.

SERIES IV.—After the bin has been filled, the grain was left in the elevator during the night. The readings, in inches in mercury, on Oct. 22, at 5 p. m., were 5.5 for column B and 4.1 for column C. Readings were again taken on Oct. 23, at 8:50 a. m., before commencing the second series of experiments, and it was found that the reading, in inches of mercury, had fallen to 5.3 in column B and 1.72 in column C. The bin was then emptied; the curves in Fig. 4 are plotted from observations made at intervals of ⅛ minute and 1 minute. The effects of suddenly opening and closing the chute were also observed.

From these observations, the maximum horizontal pressure on the bin wall

$$= \frac{1}{26}\left(40 + 20\,\frac{4.4 - 3.12}{4.65 - 3.12}\right) = 2.182 \text{ lbs.}$$

per sq. in.

The maximum pressure on the hopper bottom

$$= \frac{200}{109.36}\left(1 + \frac{7.17 - 3.64}{7.25 - 3.64}\right) = 3.617 \text{ lbs.}$$

per sq. in.

SERIES V.; EXPERIMENTS AT THE GREAT NORTHERN R. R. GRAIN ELEVATOR IN QUEBEC.

On Oct. 29, 1901, a series of experiments were carried out in one of the bins of the Great Northern Railroad elevator at Quebec. The bin was 13.4 × 12.35 ft., and the diameter of the chute was 14 ins. The hopper was first filled up with grain level to the top and the diaphragms were placed as indicated in the sketch, Fig. 8. Diaphragms D, E and F being horizontal while diaphragm G was vertical and parallel with the face of the bin. The effective sectional area of the diaphragms D, E and F was 26 sq. ins., while the effective sectional area of diaphragm G was 109.36 sq. ins. These diaphragms were carefully calibrated both before and after the experiments.

The loci in Fig. 6 have been plotted from observations with the four diaphragms taken at intervals of about 20 seconds, while the filling of the bin proceeded at approximately uniform rate.

Hence, the maximum horizontal pressure on the bin wall at the position G

$$= \frac{200}{109.36}\left(1 + \frac{3.93 - 3.64}{7.25 - 3.64}\right) = 1.976 \text{ lbs.}$$

per sq. in.

*The tables for this series and those following are too extended to be here reproduced. The curves adequately summarize the results.—Ed.

The maximum vertical pressure in lbs. per sq. in. at D

$$= \frac{1}{26}\left(140 + 20\,\frac{10.95 - 10.50}{11.95 - 10.50}\right) = 5.62 \text{ lbs. per sq. in.}$$

The maximum vertical pressure in lbs. per sq. in. at E

$$= \frac{1}{26}\left(90 + 15\,\frac{8.75 - 6.43}{6.43 - 5.37}\right) = 4.72 \text{ lbs. per sq. in.}$$

The maximum vertical pressure in lbs. per sq. in. at F

$$= \frac{1}{26}\left(60 + 30\,\frac{5.20 - 4.35}{6.37 - 4.35}\right) = 2.79 \text{ lbs. per sq. in.}$$

The last three results show that the intensity of the pressure diminishes from the center to the sides, and corroborates the theory that the grain in a bin consists of a series of superimposed dome-shaped shells, separately supported by the inherent strength of such a structural form and by the friction of the bin walls.

It is of interest to note that the magnitudes of the horizontal intensities of pressure on the bin walls correspond whether the smaller diaphragm of 26 sq. ins. sectional area is used, as in the experiments with the C. P Ry. elevator, or whether the larger diaphragm of 109.36 sq. ins. is used, as in the Great Northern elevator at Quebec, indicating that the size of the diaphragm does not appreciably affect the observations.

It is also important to note that the results obtained with the rubber diaphragms are practically verified by those obtained by Mr. Max Toltz, who by a series of most interesting experiments, observed the deflections produced on steel plates of different thicknesses and deduced therefrom, by calculation, on the assumption that the steel plate might be considered a beam, that the stress in the metal induced by the grain pressure, in no case exceeded those due to a load of about 3 lbs. per sq. in.*

THE STRENGTH OF WOODEN BINS.

As directly connected with the strength of wooden bins, the following experiments, which were made to determine the strength of the joints may be of interest.

The sketch, Fig. 7, represents the section of a bin tested on Oct. 1, 1901, its thickness being 17 ins., made up of nine 1⅞-in. planks.

In Table IX. columns A and C give the openings of the joints at A and C in the sketch under corresponding loads in the first column. Column B shows the amount by which the central depth of the bin section in the direction

*These results have not been published.—Ed.

TABLE II.—Diaphragm (C).

Time.	Position of chute.	Readings in ins. of mercury.		Time.	Position of chute.	Readings in ins. of mercury.	
		3.80		A. M.			
		3.76		11:16¼	Open	..3.97	
		3.70		11:17½	"	..3.90	
...	Open	..3.20		11:18½	"	..3.98	
...	Closed	.4.45		11:19½	"	..3.82	
...	Open	..3.75		11:20½	"	..3.79	
...	"	..4.00		11:21½	"	..3.75	
...	"	..4.15		11:22½	"	..3.73	2,000
...	"	..4.25		11:23½	"	..3.71	bush.
...	"	..4.25		11:24½	"	..3.70	
...	"	..4.30		11:25½	"	..3.65	
...	"	..4.34		11:26½	"	..3.59	
...	"	..4.37		11:27½	"	..3.54	
...	"	..4.40		11:28½	"	..3.50	
...	"	..4.40		11:29½	"	..3.47	2,500
...	"	..4.38		11:30½	"	..3.45	bush.
...	"	..4.35		11:31½	"	..3.42	
...	"	..4.30		11:32½	"	..3.40	
...	"	..4.28		11:33½	"	..3.39	
...	Closed; 500 bush. out			11:34½	"	..3.38	
...	"	..4.55	(½ min.	11:35½	"	..3.34	
...	"	..4.62	¾ "	11:36½	"	..3.30	
...	"	..4.65	1½ "	11:37½	"	..3.28	
A. M.				11:38½	"	..3.23	3,000
11:00	Open	..4.57		11:39½	"	..3.20	bush.
11:00½	"	..4.62		11:40½	"	..3.20	
11:01½	"	..4.54		11:41½	"	..3.20	
11:02½	"	..4.47		11:42½	"	..3.20	
11:03½	"	..4.41		11:43½	"	..3.18	
11:04½	"	..4.38		11:44½	"	..3.17	
11:05½	"	..4.35		11:45½	"	..3.16	
11:06½	"	..4.30		11:46½	"	..3.10	
11:07½	"	..4.26	1,000	11:47½	"	..3.09	3,500
11:08½	"	..4.22	bush.	11:48½	"	..3.08	bush.
11:09½	"	..4.20		11:49½	"	..3.06	
11:10½	"	..4.18		11:50½	"	..3.05	
11:11½	"	..4.11		11:51½	"	..3.04	
11:12½	"	..4.09		11:52½	"	..3.03	
11:13½	"	..4.02		11:53½	"	..3.01	
11:14½	"	..4.00		11:54½	"	..2.96	
11:15½	"	..3.96	1,500	11:55½	"	..2.94	
...	"	..3.95	bush.	11:56½	"	..2.91	4,000
...	Closed	.4.08		12:12½	"	..1.60	bush.
11:57½	Open	..2.94		12:13½	"	..1.34	
11:58½	"	..2.95		12:14½	"	..1:05	
11:59½	"	..2.98		12:15½	"	..0.70	
12:00½	"	..2.98		12:16½	"	..0.50	
12:01½	"	..2.98		12:17½	"	..0.22	
12:02½	"	..2.99		12:18½	"	..0.18	Empty
2:03½	"	..3.07		After interval of few minutes		..0.20	
12:04½	"	..3.14	4,500	Final		.....0.30	
12:05½	"	..3.16	bush.				
12:06½	"	..3.10					
12:07½	"	..2.94					
12:08½	"	..2.72					
12:09½	"	..2.50					
12:10½	"	..2.23					
12:11½	"	..1.90	5,000				
12:11¾	"	..1.80	bush.				

TABLE III.

Load, in lbs.	Readings A.	B.	C.
000	0.000	0.000	0.000
500	.000	.005	.001
1,000	.000	.006	.001
2,000	.000	.010	.003
3,000	.002	.018	.004
4,000	.003	.030	.005
5,000	.005	.035	.006
6,000	.006	.045	.007
7,000	.009	.050	.009
8,000	.011	.058	.019
9,000	.012	.069	.012
10,000	.016	....	.014
11,000	.018	.091	.016
12,000	.020	.101	.019
13,000	.022	.103	.022
14,000	.026	.119	.024
15,000	.029	.130	.026
16,000	.035	.145	.030
17,000	.038	.153	.035
18,000	.042	.162	.038
19,000	.048	.173	.041
20,000	.051	.185	.045
21,000	.056	.200	.050
22,000	.060	.210	.055
23,000	.067	.225	.060
24,000	.075	.240	.066
25,000	.082	.260	.0.72
26,000	.089	.270	.079
27,000	.094	.285	.085
28,000	.105	.305	.095
29,000	.111	.319	.105
30,000	.120	.335	.111
31,000	.135	.360	.122
32,000	.143	.380	.136
33,000	.165	.415	.155
34,000	.180	.445	.168
35,000	.191	.470	.180
36,000	.210	.500	.200
37,000	.225	.530	.215
38,000	.238	.550	.228
39,000	.251	.580	.249

of the load, was increased under the same corresponding loads. Cracking commenced under a load of 18,000 lbs. and became very intense under a load of 33,000 lbs. while under a load of 34,000 lbs. the yielding became continuous. Under the final load of 35,000 lbs., one of the planks in the lower side of the crib broke through just inside the joint and this was immediately followed by the breaking of another plank in the same place. This latter plank was found to be defective. These results show that the failure was actually due to a transverse fracture of the planks and indicate that the distance of 34 ins. between the opposite sides of the crib was too great to fully test the strength of the corner joint. Subsequently, on Nov. 4, a second test was made on the strength of the joints, the crib work being arranged as before, except that the thickness was about 13 ins. (made up of seven 1⅞-in. planks), while the distance between the upright faces was 13 ins. instead of 34 ins. Table IV. gives the tensile readings under increasing loads and it will be observed that under a load of 38,000 lbs., the total opening of the joints was .299-in. at A and .3-in. at C, while the central depth of the bin in the direction of the load was increased by .378-in., or a little more than ⅜-in. Under the load of 38,500 lbs., the opening of the joints became continuous although slow, and the joints finally failed under a load of 44,500 lbs.

TABLE IV.

Load, in lbs.	Readings A.	B.	C.
000	0.000	0.000	0.000
1,000	.002	.005	.005
5,000	.009	.025	.008
7,500	.017	.040	.015
10,000	.026	.049	.022
12,500	.031	.060	.029
15,000	.041	.075	.040
17,500	.053	.091	.050
20,000	.069	.110	.064
22,500	.084	.130	.080
25,000	.101	.153	.098
27,500	.126	.181	.121
30,000	.154	.210	.146
32,500	.184	.250	.175
35,000	.230	.301	.225
36,000	.252	.325	.250
37,000	.268	.351	.274
38,000	.299	.378	.300
38,500	.312	.397	.320
40,000	.395	.485	.408
41,000	.435	.530	.450
42,000	.491	.590	.510
43,000	.570	.673	.600
44,000	.675	.770	.682
44,500	.748	.815	.725

According to the fluid pressure theory, the total pressure on a portion of bin-wall, 14 ft. wide by 13½ ins. deep

$$= 14 \times \frac{13\frac{1}{2}}{12} \times 45 \times 50 = 35{,}440 \text{ lbs.},$$

the grain weighing 50 lbs. per cu. ft. and 45-ft. being the depth of grain over the center of gravity. This amount approximates very closely to the ultimate strength of the corner joints, and really exceeds the ultimate strength, as the observations showed a continuous yielding under a load of 33,000 lbs. Yet these bins do stand and give good service.

Fig. 5. Location of Hydraulic Gages in Experiments on Great Northern Elevator at Quebec, October, 1901.

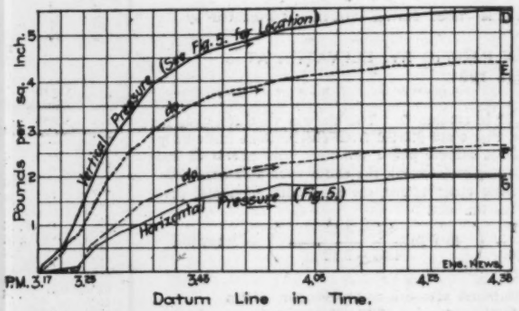


FIG. 6. HORIZONTAL AND VERTICAL PRESSURES AT BOTTOM, BIN FILLING.

THE COPPER SULPHATE TREATMENT FOR ALGAE AT ELMIRA, N. Y.

By James M. Caird.*

In view of the article in Engineering News of May 26, 1904, on the prevention of algae growths in water by means of treatment with sulphate of copper an account of such treatment at Elmira, N. Y., may be of interest to your readers.

The water supply for the City of Elmira, N. Y., is obtained from the Chemung River and also from an impounding reservoir. Both waters are filtered through Jewell subsidence gravity mechanical filters before being delivered to the consumers.

The reservoir was constructed during the year 1870, by building a dam across a natural site. At the time of construction the timber and surface soil were removed from the parts to be flooded. The reservoir has a drainage area of about 4½ sq. miles, covers 38 acres and has a capacity, when full, of 113,000,000 gallons. The supply is derived from springs and a small stream called Hoffman Creek.

The water is drawn from the reservoir by means of a floating outlet, which at the present time is set so as to take its supply about 3 ft. below the surface.

At various times the water in this reservoir has been a source of trouble owing to its strong "fishy" odor and taste, due to a growth of Anabaena and Asterionella. At times, before the construction of the filter plant, it was necessary, on account of the odor and taste, to drain and clean the reservoir, the last cleaning being done during the summer of 1889. The growth has been so abundant that even in the winter, when it was necessary at times to use this supply, lime had to be added before filtration in order to remove the "fishy" taste.

At the time of treatment with copper sulphate, the water was about 3 ft. from the overflow, the reservoir then containing about 90,000,000 gallons.

The copper sulphate was applied by placing 50 lbs. at a time in loose sacks and hanging them from the stern and sides of a row boat, so as to have them partly covered with water; in this manner about 150 lbs. would be dissolving at a time. A sack containing 50 lbs. was thrown into the stream which enters the reservoir and allowed to dissolve, so as to have all of the water treated as nearly as possible at the same time. The temperature of the water at the time of treatment was 64° F.

In all 1,000 lbs. of copper sulphate were used in treating the 90,000,000 gallons. This was equal to 1 1-3 parts of copper sulphate per 1,000,000 parts of water, or 1 1-3 lbs. for every 120,048 gallons of water.

The reservoir was treated June 25, and none of the water was used until June 27, 36 hours after treatment. A sample of one litre, taken on June 27, and evaporated to 100 cu. cm., failed to give the copper reaction when tested with potassium ferro-cyanide.

No rain fell on the drainage area from June 21 until after samples had been taken from the reservoir on June 30. The results of analyses of samples taken before and after treatment are shown in the accompanying table.

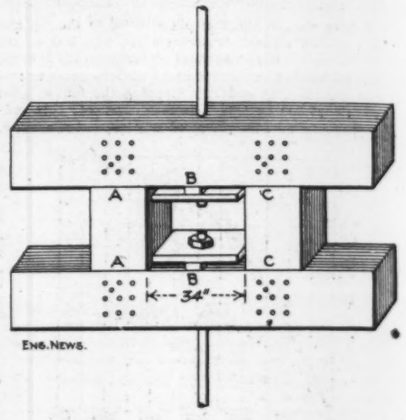


Fig. 7. Sketch of Model for Testing the Strength of Joints in Wooden Elevator Bins.

Examinations of Water from Reservoir at Elmira, N. Y., Before and After Treatment for the Removal of Algae.

	Before treatment, June 24.	After 36 hours, June 27.	After 84 hours, June 29.	After 108 hours, June 30.
Odor	fishy	slight	very slight	very slight
Color	25	25	22	22
Turbidity	51	35	28	28
Alkalinity	17	17	17	17
Bacteria per cu. cm.	315	42	26	18
B. Coli communis*.	2 out 5	0 out 5	0 out 5	0 out 5
Anabaena	260	0	0	0
Asterionella	24	5	0	0

*Number of times found in the samples.

The anabaena disappeared 36 hours after treatment while the asterionella disappeared 84 hours after the treatment. In looking over the preceding table it is seen that there was a reduction in bacteria of 86.7% in 36 hours; 91.8% in 84 hours, and 94.3% in 108 hours.

Before treatment five samples of 1 cu. cm. each were examined for B. coli communis, two gave positive results; 36 hours after treatment this bacillus could not be found.

In operating the filters it was found that after the treatment the period between washings had been increased three hours, and the wash water was reduced from 2.3% to 1.9%.

At present (July 8, 1904) it is not known whether or not it will be necessary to treat the reservoir again this season.

Immediately after treating the water in the shallow parts of the reservoir, the "pollywogs" began to come to the surface in large numbers, dying in about one hour. The fish did not begin to die until about five hours after the treatment had been completed.

The effect of the copper sulphate treatment on the different animal life was as follows: Numerous "pollywogs" killed, but no frogs; numerous small (less than 2 ins. long) black bass and two large ones (8 ins. long) killed; about ten large "bullheads" were killed but no small ones; numerous small (less than 2 ins. long) "sunfish" were killed, but no large ones.

The wind brought the dead fish to the corners of the reservoir, and it was very little trouble to remove them. No dead fish were seen 24 hours after the completion of the treatment.

The sulphate of copper cost about 57 cts. per 1,000,000 gallons of water, and was applied to 90,000,000 gallons by two men using one boat, in less than eight hours.

*Chemist and Bacteriologist, 271 River St., Troy, N. Y.

A GERMAN LONG-SPAN CANTILEVER HIGHWAY BRIDGE.

Last week we noted very briefly that a cantilever bridge was soon to be put under construction in Germany, which will have the longest span of any bridge in that country. We deem it a matter of general interest to show, herewith, a drawing of the contract design, as given in the "Schweizerische Bauzeitung" of June 18, 1904, in an article by Mr. F. Bohny of Mainz. The design won first prize in a closed competition called last December by the cities of Ruhrort and Homberg, which the bridge is to connect. The contract was let to the designer of the successful plans, the Gustavsburg Bridge Works of Mainz, in May of this year, and work is to be commenced in autumn. The period of completion is specified at 2½ years.

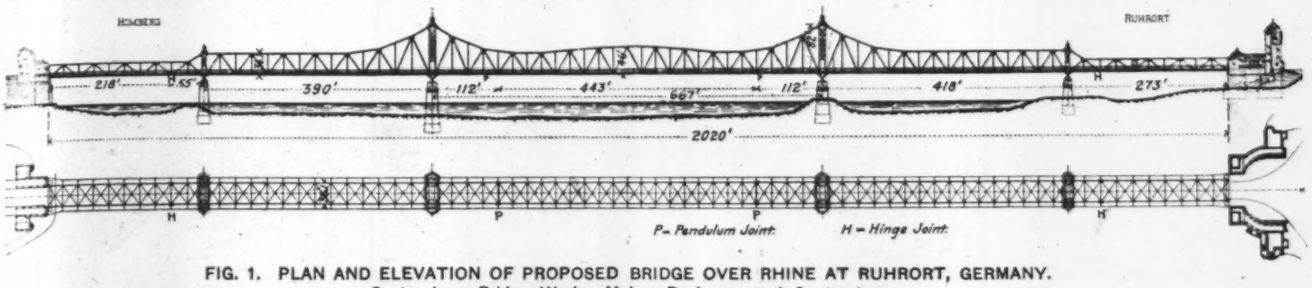


FIG. 1. PLAN AND ELEVATION OF PROPOSED BRIDGE OVER RHINE AT RUHRORT, GERMANY.
Gustavsburg Bridge Works, Mainz, Designers and Contractors.

The Rhine River is about 1,200 ft. wide at the proposed crossing, and carries a very heavy traffic of tug boats and barges, principally in the coal trade. The scheme of construction of the proposed bridge was required to be such as to offer minimum interference with this traffic. Certain portions of the width of the stream were to be kept wholly clear of obstruction, particularly on the Ruhrort side where lies the approach to the harbor of that city.

The conditions seemed to call for a cantilever bridge, adapted to be erected with a minimum of falsework.

The accompanying Fig. 1 shows the general design of the successful competitor in side-elevation and plan. The central opening, 667 ft. between pier centers, contains a suspended span (443 ft.), and the approach spans in the extreme side openings are also "suspended." The intermediate portions are continuous, resting each on a main pier and a side pier, and cantilevering over the pier at either end. A particular feature of the design is that the central suspended span has a curved top chord, so that the points where cantilever arm and suspended span meet are the shallowest points of the truss. This suspended span is hung to the cantilever arms by pendulum supports, giving free expansion. The main trusses are supported by fixed shoes on the main piers, and have rocker supports on the side piers, to avoid temperature stresses. The approach spans, being pinned at their junction to the cantilevers, require roller shoes on the abutments.

The lower lateral system extends across the entire bridge, being joined at the hinge-points in the same manner as the main trusses. The upper laterals, however, extend only between the side piers, so that the approach spans are of the "pony" type. The main trusses are 11 m. (36 ft.) apart, giving a roadway of 29½ ft. The total width between sidewalk railings is 52½ ft. The truss panels vary from 24½ to 29½ ft. in length.

The floor will probably be of troughing or Z-bars, covered with concrete. The roadway pavement is to be of wood-block, that on the sidewalks, sheet-asphalt.

It was required that the entire right-hand side span (under the main cantilever trusses) should be kept clear of falsework, and the same for a width of 100 m. (or two openings of 50 m. each) in the central span. It is therefore planned to erect the left portion, as far as the main pier, on falsework, then build out cantilevering up to the center, locking the hinge-joint meanwhile. Then, a temporary pedestal is to be put in at the center, the left-hand hinge released, and the bridge built on across the central span and the adjoining side span, locking the right-hand hinge in this operation. The right-hand approach span can then be put in on falsework, completing the bridge.

Attention may be called to the end portal towers, which were designed by the architect who collaborated with the designing engineer. Each is a heavy-appearing mass of masonry, forming a hemicyclic entrance to the bridge; the hemicycle is flanked with a low square tower at either extremity. It will be recalled by our readers that heavy and imposing masonry portals are a typical appendage to all highway bridges of any magnitude in Germany. These portals are, we believe, in no case utilized for any specific purpose, but are constructed solely with a view to enhancing the aesthetic effect of the structure. A further point at which the work of the architect appears in the present design, is at the little gable roofs with turrets, set over the bridge on the line of the piers. Fig. 2 shows these as seen from their side, though in the view of the bridge from the stream (see Fig. 1), they are very much less obtrusive.

SHUTTERS AND OTHER DEVICES FOR PROTECTION AGAINST EXPOSURE FIRES.*

By John R. Freeman.†

A point which interested me exceedingly, in studying the Baltimore ruins, was to see whether thin wrought iron or steel plate, such as is used for covering fire-shutters, had at any point been heated to a temperature where its power or resistance was seriously impaired. The ordinary underwriters' fire-shutter depends for its strength and its resistance upon its thin covering of very soft mild steel coated with tin. I examined thin sheet-steel lamp shades, thin bands for pipe coverings, tin boxes, filing cases, and dozens of shutters themselves. In no place did I find any indication that metal of that quality had been so softened, or had reached such a heat that it would be seriously impaired for the purpose of fire-shutters, and one of the great lessons that I brought away from the Baltimore fire was that our standard tin covering for the underwriters' shutter is all right, and that this covering material has sufficient power of resistance to withstand the fiercest heat of a great conflagration, but that we do need to find some better material than pine wood to fill it with. I also made careful examinations of copper in flashings, cornices, etc., to see if it had melted. In a few small spots in rare instances fusion had begun, but in general I found it had ample resistance to fusion, so that it can prudently be used for covering fire-shutters, where something more ornamental or weatherproof than tinned plate is desired and expense is no bar.

The Standard Underwriter Shutter of wood covered with tin did not give a very good account of itself in the Baltimore fire, and I think it can be said, without fear of serious contradiction, that the endurance of the ordinary underwriters' shutter of tin-clad wood is limited to not more than about half an hour's endurance of a temperature of 1,500° F., and that this limit is often passed in the heat of an ordinary conflagration, and that in many of the cases where single doors or shutters have shown up so well there has happened to be an incoming air current that has helped to cool the shutter.

The limitations of the tin-clad wooden shutter were shown at one corner of the burned district in Baltimore. A large shirt factory, whose windows were protected by wooden fire-shutters, had a very close call. By heroic efforts, with private pump and hose streams, the employees saved the factory. I took particular interest in examining those shutters, and although this was not at the hottest part of the fire, I found, in parts of the shutter at the hottest exposure, that the pine wood was charred entirely through and all gone.

This matter of better shutters is one on which we should set some of our best talent at work in the experimental way. Although the present shutter and the present approved form of fire-door is all right nine-tenths of the time, and perhaps nineteen-twentieths, of the time, it is not all that we need in a great conflagration.

I have said that buildings can be made fireproof against bad exposures. The possibility of making them so is found largely in the development of a superior thin form of fire shutter, and in educating the architects and owners of buildings toward building a shape of window that is easily protected by the fire shutter, and a neat window-jamb formed to receive this shutter when folded back inside the window.

Windows of suitable size for all ordinary office purpose can easily be so designed that they can be protected by fire-shutters, and that the shutters when open and folded back on the inside will not be obtrusive or unsightly. When a bad exposure fire comes the ruin of the sash and glazing can be paid for cheerfully if the contents of the building are saved.

I was very much interested in the efficiency of the plain steel plate shutters on the inside of the windows in the Safe Deposit & Trust Co. Building. These kept the fire out very successfully, notwithstanding that the large non-fireproof building of the "Baltimore Sun," which was entirely wrecked, and was one of the hottest parts of the entire conflagration, was only 10 ft. away. The damage was so imminent that the police ordered the men to leave the Safe Deposit Building and the heat melted the lead sash-weights within the cast-iron window-casings, destroyed the sash and glass, and chipped the brick walls, but the damage on the interior of the building was almost nothing. These steel plate shutters were so set that they were free to expand, and they were free from ribs, and of a form not likely to warp much, and they did in fact warp but little, and the casing and jamb were of such form that this warping of the shutter off its seat did not open a wide crack, and there was no combustible material near them on the inside to receive their radiant heat.

Ribs are dangerous unless very carefully designed, and attached, and as generally applied, increase the liability to warp. I happen to have been an eye witness of the fire 20 or 25 years ago that gave to the tin-clad shutter its great start on the road to popularity. This fire was in the Pacific Mills, at Lawrence, Mass. In that case there was a tin-clad wooden fire door, of what has since become standard construction, standing immediately beside a steel plate shutter that was heavily ribbed on the edges. Apparently it was a fair comparative test for the two shutters. The ribbed steel shutter warped away from its bearings 2 or 3 ins., as I now remember it, in a way that let the fire play freely around its edges, while the tin-

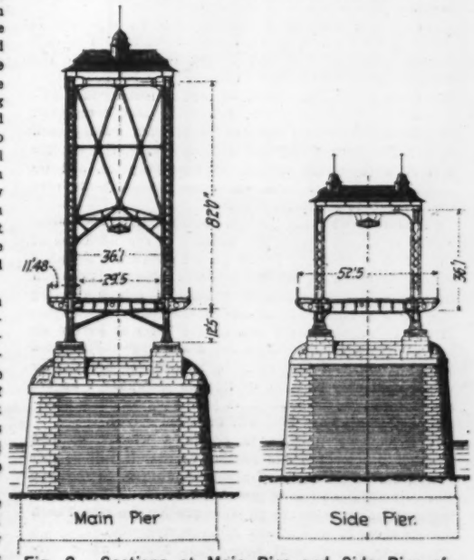


Fig. 2. Sections at Main Pier and Side Pier of Ruhrort Bridge.

*Extract from an address at the annual banquet of the National Board of Fire Underwriters, New York city, May 12, 1904.

†Consulting Engineer, Providence, R. I.

clad wooden shutters remained in place without warping and was in good working order when the fire was over; the tin covering intact and the wood charred only about half an inch deep. These results were published far and wide, and this gave the first great impetus to tin-clad wooden shutters.

There have since been hundreds of demonstrations of the endurance of tin-clad shutters in fires, and I have taken advantage of many opportunities to examine carefully into the conditions under which they have been exposed. The result of these examinations has been to convince me that the endurance of the tin-clad shutter is limited; that its limit of endurance is often passed; that for severe cases we do need something better than the ordinary underwriter's tin-clad wooden shutter, and that we do need something very much better than the ribbed steel shutter or the rolling jointed steel shutter.

At present the best we can do in any important case is to use two fire shutters or fire doors, one outside and another inside; one will receive the brunt of the onslaught, and perhaps in the course of half an hour or an hour warp or break down; the second, shielded behind the first, will stand up to its work until any ordinary fire is over.

It seems to me that the main reason why those steel shutters in Baltimore, at the building which I have just mentioned, performed so well was that they were free from ribs, and thus became heated more uniformly, with but very slight warping; that they happened to be so fastened to a frame that they were free to expand, and their seat happened to be of such a shape that, although the shutter did warp a little, this did not open much of a crack, and that there was no combustible material close to them on the inside.

The path of safety from exposure fires for office buildings and the like, lies in a window casing formed so that we can attach to it a shutter of a form similar to the ordinary inside house-blind. Our ordinary business buildings have walls thick enough, so that by making the shutter in four folds, or leaves, two being hinged together, and these two in turn attached to the wall, making each fold in the shutter only about 15 ins. wide, the window will be wide enough for all practical purposes, and we can fold the shutter back within the window jamb, very much as we do the inside blind.

To do that with the present ordinary tin-clad shutter would be almost impossible, because of the thickness of that form of shutter. It can be done with a steel plate shutter without ribs, and the radiation from the inside can be checked by some thin incombustible porous covering like asbestos board. If in our underwriters' laboratories, in our technical schools, and in our tours of survey we can direct attention to these views and urge the solution of the problem of how to make an efficient fire shutter which shall only be ¾-in. or 1 in. in thickness, I believe that before long the problem of protecting an office building against exposure fires will be found solved.

It is entirely possible to design a window opening adapted to receive a safe shutter, so that it will be just as convenient for ordinary business purposes as the type now common. I think it probable that the best place for the shutters is inside the glass, sacrificing the glazed sash outside them in case of any great conflagration.

We hear a good deal now-a-days about "water curtains," and I would like to say just a word on that, because I think there is a great deal of misapprehension about their efficiency. I would like to say a word about wire-glass also, because, although in general excellent, I think there is a great misapprehension as to what wire-glass can do.

I began experimenting with wire-glass very soon after it first came out, and I have used it in numerous instances, and it is a most excellent material in its way, but it has its limitations; it has the same limitations that a water curtain has, and that is, that it does not stop the passage of radiant heat.

You all have noticed how, when you are traveling in a railway train, perhaps at 60 miles an hour, and they happen to be burning a pile of ties along the track, that although your face is directed towards your newspaper, you will feel the flash of heat passing through the car window and striking against your face as you go past that pile of burning ties. That simply illustrates the great ease and rapidity with which radiant heat passes through glass.

Now, radiant heat passes through glass with wire netting in it almost as easily as it does through any other glass, and the record made by wire-glass in a certain building in Baltimore, which is pointed to with so much pride, is, I think, simply due to the fact that it was at a place where nothing combustible was immediately behind it. If you have a stock of dry goods, or wooden ware, or baled cotton or hemp just inside a wire-glass window without shutters, and there is a hot fire across the street, these can probably be set on fire with much promptness by the radiant heat passing through the glass, and the subject should be thoroughly studied on a large scale in our underwriters' laboratories. For safety, there must be something which will stop the radiant heat, and that can only be in the form of a shutter, and, by virtue of stopping the heat, the shutter will become hot.

The case with the water curtain is very much the same as with the glass. Water is diathermous, as physicists call it—that is, radiant heat passes through water very easily. We must, I believe, set down these stories that have been told about the efficiency of water curtains as being mainly fairy tales.

This supposed efficiency of the water curtain is another topic which I hope that some one of our underwriters' laboratories and some of our schools of applied science will take up and investigate with precision of measurement.

I have heard stories of the wonderful efficiency of the water curtain, but I must beg to disbelieve them, largely on the theoretical ground as yet. It is a matter which can be tested very easily.

The window sprinkler came in for a good deal of praise in certain quarters in Baltimore. I took particular pains to investigate that, because I wanted to find just how far they merited it, and I have no doubt they did some good, but they are not entitled to anything like the glory that is claimed for them. They will tell you a great deal about the remarkable work done by the window sprinklers in the Toronto fire. Now, I sent a bright young engineer up there especially to investigate that question and to go into it in detail, and to take photographs of the individual windows and to get right down to the bed-rock facts, and from the mass of evidence that he brings back, I do not doubt that they did some good; but the inside ordinary automatic sprinkler near each of these windows did very much more good.

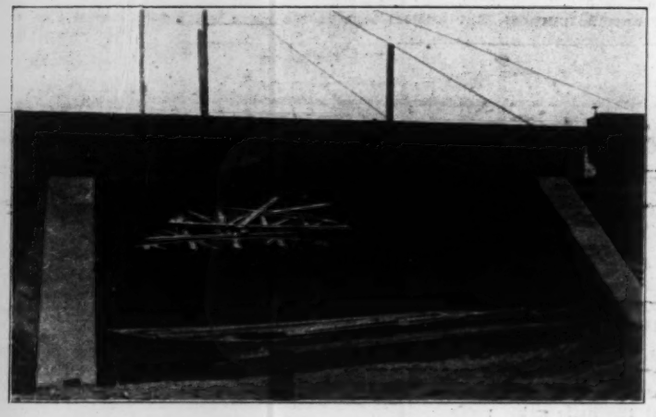
In short, if you want to provide against an exposure fire, I believe this the only way to do it is

First, by a wall either of brick or cement concrete.

Second, by properly designed window openings and window casings, and

Third, by good shutters in those windows.

In the absence of shutters, automatic sprinklers, supplemented by heroic efforts with hose streams on the inside, may sometimes save the day; with great expense for water damage, but where exposures are bad, a good shutter on a proper window should be the first care of architect and owner.

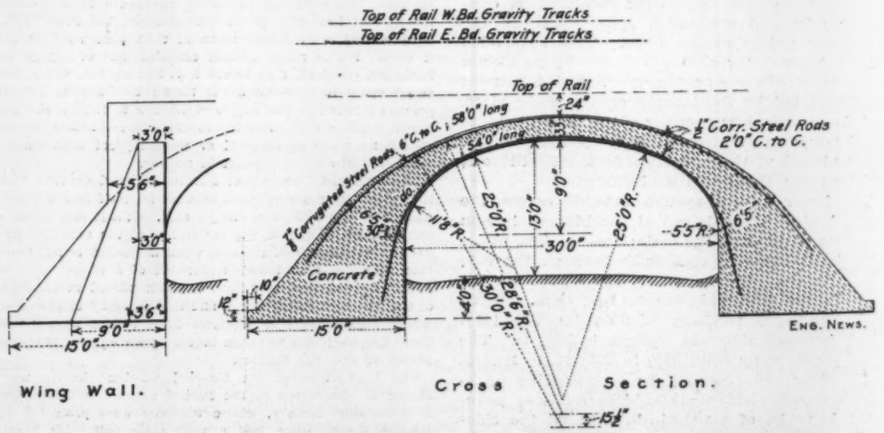


REINFORCED CONCRETE ARCH FOR HIGHWAY UNDER TRACKS OF LAKE SHORE & MICHIGAN SOUTHERN R. R., ELKHART, IND.

COST OF REINFORCED CONCRETE BRIDGES; LAKE SHORE & MICHIGAN SOUTHERN RY.

The yards of the Lake Shore & Michigan Southern Ry. at Elkhart, Ind., were rebuilt in 1903 to provide for the gravity system of switching, and in connection with this work three bridges or subways of reinforced concrete were built to carry the La Rue Highway under the main tracks and two groups of yard tracks, in order to eliminate the grade crossings. These subways are respectively about 40, 60 and 160 ft. long, exclusive of wing walls. They are built as arches of 30 ft. clear width and 13 ft. headway, with a thickness of 28 ins. at the crown. The steel reinforcement consists of longitudinal and transverse bars of the Johnson corrugated pattern, made by the St. Louis Expanded Metal Fireproofing Co., of St. Louis. The longitudinal bars are laid 2½ ins. from the extrados and intrados and spaced 6 ins. c. to c.; across these are the transverse rods, 2 ft. c. to c. The accompanying cuts are from photographs of the completed arch under the main tracks.

The proportions of concrete were generally 1



PART ELEVATION AND SECTION OF REINFORCED CONCRETE ARCH AT ELKHART.

cement, 3 gravel and 6 stone. The material called gravel was dug from the foundations, and was about 50% sand and 50% "gravel" ranging up to the size of pigeons' eggs. It varied somewhat, however, and the cement was varied accordingly, there being somewhat more cement used when the proportion of sand in the gravel was greater. The concrete was mixed by machine, and a wet mixture was used. The work was done by the railway company's forces.

For plans and information we are indebted to Mr. Samuel Rockwell, Assistant Chief Engineer, and he has also furnished the following statement of itemized cost, which is of particular interest in view of the great extent of work of this kind which is now being constructed. The low cost of sand is due to the fact that this was obtained from the foundations, as above explained. All account of freight charges is purposely omitted.

Cost of Reinforced-Concrete Subways at Elkhart, Ind.; L. S. & M. S. Ry.

		Av. cost per cu. yd.
Temporary buildings, trestles, etc..	$752.33	$0.15
Machinery, pipe, fittings, etc.....	416.34	.08
Sheet piling and boxing.....	1,006.12	.21
Excavating and pumping	1,619.74	.33
Arch centers and boxing.....	3,528.92	.73
Concrete masonry: Cement.	$8,860.55	
Stone	1,788.50	
Sand	240.00	
Drain tile	103.03	
Labor	8,091.41	
	$19,083.49	3.95
Steel reinforcing rods	3,028.39	.63
Engineering, watching, etc.....	508.40	.11
Total	$29,943.73	$6.19

Contents, 4,833 cu. yds.
Johnson steel rods were put in according to Monier plan.

STEEL MASTS FOR SHIPS.

In many large steel sailing vessels and steamships the masts are built of steel, and we give herewith drawings of the bowsprit and one of the masts of a six-masted schooner built by the Fore River Ship & Engine Co., of Quincy, Mass., the drawings being approved by Mr. B. B. Crowninshield, Naval Architect. This firm built the seven-masted steel schooner illustrated and described in our issue of Nov. 6, 1902.

In the bowsprit, Fig. 1, the circular section is made up of four curved plates, with a 3-in. lap; and there are four interior stiffening angles. For a length of 17 ft. near the heel there is a vertical diaphragm or web plate riveted to the top and bottom stiffener. These angles are 5½ × 3½ ins., 14½ lbs. per ft. The circumferential joints of the plates are covered with butt straps, as shown. The total length of the bowsprit is 83 ft.

The masts, also shown in Fig. 1, are 112 to 132 ft. high from heel to top, and the circular section is made up of three plates. There are four interior stiffening angles, and on the after side is a jackstay or rib formed by a bar 1¼ × 2½ ins. against the mast and an outer bar ¾ × 4 ins. This jackstay is riveted to the mast by a double row of staggered rivets, ¾-in. diameter and 8 ins. pitch in each row, as shown in the detail drawing, Fig. 2.

SOME OBSERVATIONS OF THE DESIGN OF REINFORCED CONCRETE BRIDGES.

By W. J. Douglass.*

During the month of March the writer took a trip through a portion of the east and middle west for the purpose of inspecting concrete and concrete-steel bridges in order to profit by the successes and failures of the various bridges of these two classes which he had an opportunity of inspecting. Based on his observations during this trip of inspection he would submit the following suggestions:

One of the first things to be decided in building a concrete steel arch, is the form of the arch curve. A large proportion of the structures built have of necessity a small rise in proportion to their span. Results of experience appear to show that such arches should be segmental rather than three or five centered or elliptical. It is apparent that in these multi-centered arches of low rise the portion near the crown acts rather as a beam than as an arch. In nearly all flat arches, which were inspected, most of which were elliptical, the arches cracked on the haunches, the joints opening up at the extrados of the arch and the crown sinking from ½-in. to 3½ ins. This sinking is not only structurally bad, but is exceedingly offensive to the eye.

If flat arches are necessary to get a maximum waterway, so that an elliptical arch is almost imperative, I believe that the concrete-steel arches should have the steel and concrete both increased about 50% over that indicated by the elastic theory, using as a unit of compressive stress 300 lbs. per sq. in. for concrete and 10,000 lbs. per sq. in. for steel and a tensile strength of zero for concrete. In a great majority of cases not only the arch ring had cracked, but this crack was continuous through the spandrel and coping above. In order to lessen the probability of the spandrel cracking, I would insert steel bars in the same way as was done in the Quarry Road Bridge, Washington, D. C. (Eng. News, Oct. 31, 1901).

The coping should preferably be cast on the ground and set in place; but if for economical reasons this is not practicable, it should be cast in place in alternate sections of about 4 to 6 ft. I would suggest in this connection that it might be well to use lime mortar rather than cement in these joints; this will make the joints of the coping open rather than crack the coping itself.

*Engineer of Bridges, District of Columbia, Washington, D. C.

In most of the cases where the sinking of the crown was of any magnitude, this sinking had carried the parapet or balustrade down with the crown, with the result that from the sidewalk of the bridge the sinking was much in evidence and very disagreeable to the eye. In order further to guard against this aesthetic fault I would suggest that the balustrade or parapet be built after the arch has been struck.

From a careful inspection of cement balustrades and parapets, with some little experience in the execution of such work, I believe that concrete railings should not be built, because they will not bear the close inspection, which from their position they must necessarily receive. In the plans for our Connecticut Avenue Bridge we have used granite coping and granite posts and bronze railings between the posts rather than use concrete. Even with the greatest care we have as yet been unable to cast concrete with a cement face without having hair-cracks appear in the surface. The hair cracks of course are not serious structurally, but to the layman, who has a right to criticize the work, they are invariably objectionable and necessarily reflect on the engineer responsible for the work.

Where the concrete railings or parapets are essential architecturally or economically, I believe much better results can be obtained by not facing the concrete with mortar at all where the design permits such treatment. In this case the work should be finished either by brushing out the mortar with wire brushes while the mortar is green, which gives a good rustic finish, or by tooling.

If a mortar face is desired, I believe that it is essential to use a coarse sand, low in silt, and a mortar somewhat leaner in cement than is the custom. It seems to have been the custom in the past to use a richer mortar in the balustrades or parapets than in the facing of the arches and spandrel walls, in consequence of which such balustrades are invariably hair-cracked while the balance of the bridge is in excellent condition. (From the best available data I am advised that in some cases the mortar has been used as rich as 1:1; but I think that it would be better to use 1:3 or 1:4)

In many cases where the balustrade is hair-cracked and the balance of the bridge is in first-class shape, I attribute the hair-cracking largely to the fact that the balustrade has been finished by floating on a thin skin of mortar in order to get a better finish. This practice I know from personal experience to be bad, and where you use exceptionally rich mortar say 1:1½ or 1:2, it is fatal. I believe the best way to treat the surface is to tool it after taking off the form, in order to take off the form marks and to give texture to the structure. This tooling further carries off the efflorescence which so frequently works to the face, and this treatment further obscures the hair-cracks if they develop. Mr. Quimby, Engineer of Bridges of the City of Philadelphia, gets a very nice finish with an ordinary scrubbing brush.

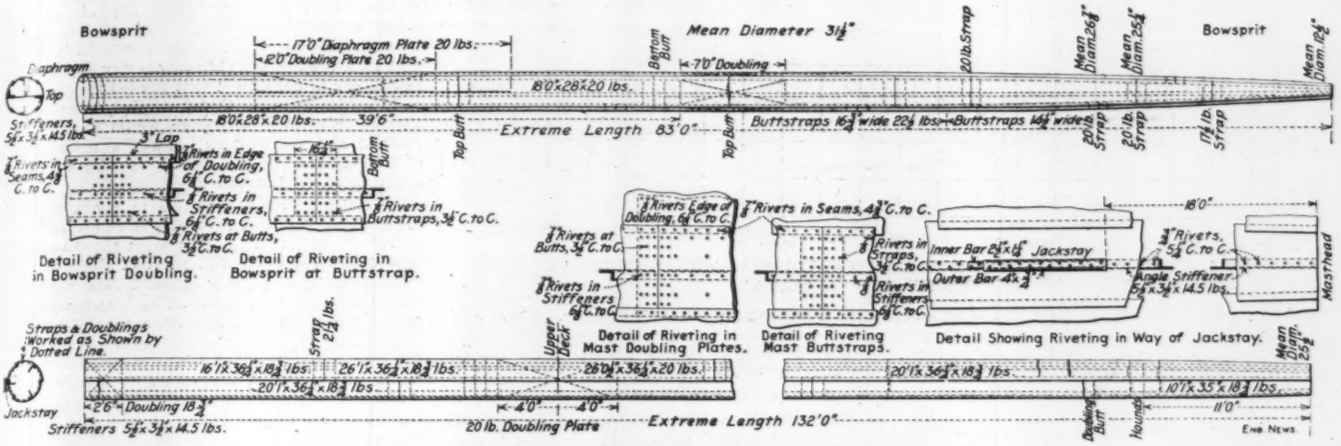


FIG. 1. STEEL BOWSPRIT AND MASTS FOR SIX-MASTED SCHOONER.
Fore River Ship & Engine Co., Quincy, Mass., Builders.

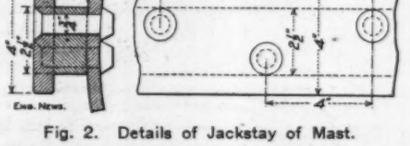


Fig. 2. Details of Jackstay of Mast.

Form marks are objectionable to the eye, but if economy prevents the tooling or brushing of the surface, in my judgment it is better to leave them on rather than attempt to cover them up by floating. In fact for such work as river piers, which do not have to bear close inspection, I would recommend leaving the form marks on and believe that the best result is obtained by simply spading the concrete and omitting the mortar face. The bridge at Dayton is an excellent specimen of this class of work.

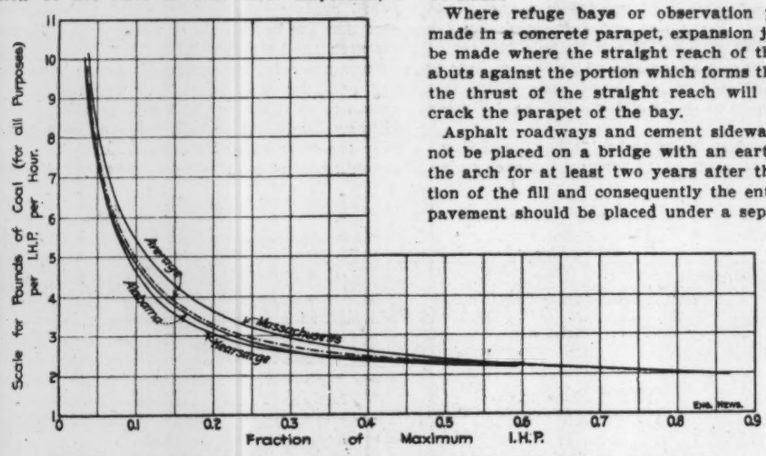


FIG. 1. COAL CONSUMPTION OF U. S. BATTLESHIPS "MASSACHUSETTS," "KEARSARGE" AND "ALABAMA."

I believe, though possibly from insufficient data, that concrete which has been mixed wet, commonly called "soup," gives the best results.

I have for the last year or so been in favor of casting concrete blocks, particularly when of ornate design, in sand; but I do not feel fully convinced that there are advantages other than economy in casting in sand, if the concrete cast in wood or iron or plaster is kept wet. In the case of iron or plaster forms this cannot be done except by removing the forms as soon as set, say fifteen hours, and properly protecting the product immediately upon such removal.

It is unfortunately a fact that in nearly all the concrete and concrete steel bridges which have been built, the profession has not made sufficient allowance for expansion. In steel bridges expansion seems to take care of itself, but in concrete and concrete-steel work it is a matter of vital importance. Errors in design should be rather on the side of too much probable expansion rather than too little. The Quarry Road bridge, which was built in Washington several years ago, is not above criticism in this respect. The spawling at the joint of the handrail and rail base and the coping is sufficient warrant of the insufficiency of expansion joints. Another point worth noticing in the Quarry Road bridge is, that the rail itself has a camber, and a couple of summers ago the rail rose, when the bridge rose, about ½-in. (due to expansion); but in the winter when the bridge went back to its normal level the handrail stuck fast and pulled away from the balustrade. This indicated two things: one that a camber in the handrail is not a good thing to build and if built at all care should be taken to overcome the trouble, due to expansion.

The use of metal pipes for draining the fill above the arch is bad practice where the soffit of the arch is subject to the inspection of the public, on account of the staining by the rust. Metal trimmings of any kind other than bronze should be reduced to a minimum for the same reason. The drainage of the arches of the spandrel walls should be carefully studied, as in many cases the seepage of the water through the concrete discolors the cement face very much. I believe that one of the best methods of waterproofing is tarring, and where this is backed up with four or five inches of puddle clay the walls are almost certain to be dry. The back fill of a concrete bridge should never be puddled; as even with the best waterproofing it is highly probable that the face of the bridge will be discolored by the seepage of the water carrying some silt with it.

The bonding of a thick wall of concrete with a thin one nearly always causes the thin one to crack and is a point of decided moment in designing work of concrete. The doweling of iron railings into concrete should be avoided if possible, and where it is not possible the dowels should be small.

Where refuge bays or observation places are made in a concrete parapet, expansion joints must be made where the straight reach of the parapet abuts against the portion which forms the bay, for the thrust of the straight reach will invariably crack the parapet of the bay.

Asphalt roadways and cement sidewalks should not be placed on a bridge with an earth fill over the arch for at least two years after the completion of the fill and consequently the entire bridge pavement should be placed under a separate contract from that for the bridge proper. About 33% of the masonry bridges inspected have badly cracked pavements, due to paving before the fill has fully settled.

METHODS OF ESTIMATING THE COAL ENDURANCE OF A NAVAL VESSEL.

By D. W. Taylor,* Naval Constructor, U. S. N.

The estimation of the radius of action of a naval vessel is a problem into which there enter so many varying factors that any solution must be an approximation at best, and hence open to question and criticism. The factors affecting the coal consumption of a vessel at a given speed may be enumerated as below:

1. The condition of the ship's bottom, whether clean or foul.
2. The wind and weather conditions.
3. The quality of the coal.
4. The condition of the machinery, main and auxiliary.
5. The skill and efficiency of the personnel.
6. The original design.
7. The amount of auxiliary machinery and steam appliances in use other than those required for propelling the ship.

Conditions may arise where any one of the first five factors above may be more powerful in influencing the radius of action than the factor of original design. The seventh factor is one which is exceptionally influential in the case of our men-of-war, which use much more steam for mechanical ventilation, heating, electric lighting, distilling fresh water, etc., than foreign vessels of war. This factor is the only one whose influence upon coal endurance may be readily magnified or decreased at will. While under ordinary circumstances, as stated above, it is generally larger for our men-of-war than for foreign vessels, it should not be forgotten that it can be readily reduced in an emergency.

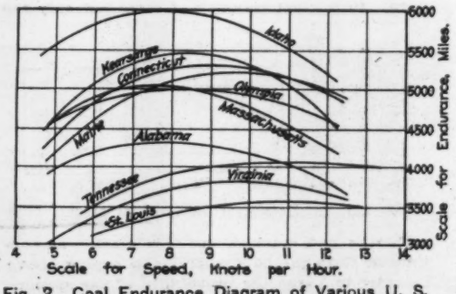


Fig. 2. Coal Endurance Diagram of Various U. S. Naval Vessels Plotted from Estimated I. HP.

Bunker Capacities.		Bunker Capacities.	
Name.	Tons.	Name.	Tons.
"Connecticut"	2,200	"Alabama"	1,270
"Virginia"	1,704	"Massachusetts"	1,580
"Idaho"	1,750	"Tennessee"	2,000
"Maine"	1,800	"St. Louis"	1,500
"Kearsarge"	1,550	"Olympia"	1,170

*Navy Dept., Washington, D. C.

The five factors first enumerated above are subject to erratic variations. Hence we must expect to find the coal consumption of a given ship in service varying erratically. Conversely any method of estimating coal consumption will give results seriously discordant with what will at times be experienced in practice.

From one point of view it would seem most logical and scientific to estimate the radius of action of naval vessels under the most favorable circumstances, that is, with clean bottom in calm weather and smooth water, using the best coal with all machinery in the best condition, with the best skill used in working machinery and with no machinery in use except that needed for propelling and handling ship. Under these circumstances the factor of original design would be no longer masked and the skill as regards coal endurance of the designer of the machinery would be duly appreciated or discredited.

It is the universal practice to try a ship for speed under the most favorable circumstances and accept the fact that the maximum speed to be expected in service will fall short of the maximum trial speed by a varying amount. The matter of coal consumption is, however, on a somewhat different basis. In actual service men-of-war are seldom pushed to the utmost, and the fact that on the rare occasions when they are so pushed their speed will fall somewhat short of what was attained on trial is a matter of rather remote bearing on the everyday conduct of the ship or fleet. When it comes to burning coal, however, we are dealing with a matter of everyday experience. It may be of interest to the people on the ship to know what the coal consumption would be in case an almost impossible combination of circumstances should supervene, but for practical purposes it is a necessity that they should know with reasonable certainty the actual coal consumption under given circumstances. Each ship in service is constantly acquiring experience on this subject, and, after a reasonable accumulation of such experience, the people on board know sufficiently well what may be expected from her. Now, shall the designer estimate the endurance under absolutely the most favorable circumstances, or shall he aim at the determination of the endurance that may be expected to be averaged in practice? It seems obvious to me that the latter course has the balance of advantages in its favor. One paramount advantage is due to the fact that in estimating actual endurance the results of everyday experience are available as a basis. The Bureau of Steam Engineering has a large accumulation of such results, and the average consumption results for a number of our ships, based on the records

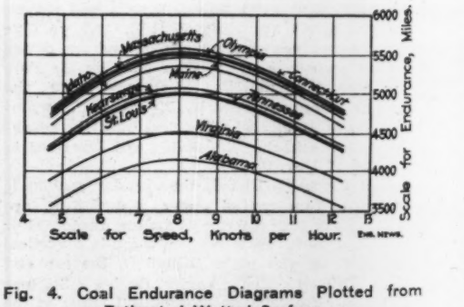


Fig. 4. Coal Endurance Diagrams Plotted from Estimated Wetted Surface.

of the Steam Engineering Bureau, have recently been published.

Having settled the broad lines upon which to work, I will take up next a few basic considerations.

If for a given ship we know the indicated horse power which must be developed to maintain a given speed and the coal which must be consumed per hour for each indicated horse power, the consumption at that speed is known. The engines of naval vessels burn more coal per I. HP. as the I. HP. is reduced. As the variation from

ship to ship is not so very great, a reasonable method of approaching the question of variation of consumption per I. HP. would seem to be to plot the coal per I. HP. as ordinates over fractions of the maximum I. HP. of the engine as abscissae, the maximum I. HP. developed by the engine being taken as unity in each case. It would be slightly more correct theoretically instead of using the fractions of maximum I. HP. to use the mean effective pressure, but for present purposes this does not seem necessary.

The only large ships in our service for which we have accurate I. HP. curves and coal consumption data are the "Alabama," "Massachusetts" and "Kearsarge." Fig. 1 shows for these ships curves of pounds of coal per I. HP. per hour plotted over fractions of the maximum trial I. HP. The I. HP. used is that of the main engines only, while the coal consumed is that for all purposes. The curves of coal consumption of Fig. 1 should not be compared with curves of coal consumption as generally given without fully realizing that they show total consumption per I. HP. of main engines only, and are the average of numerous results in service obtained with various conditions of bottom, various displacements and various qualities of coal. Hence they are necessarily materially higher than would be shown in any coal consumption trial.

The curves of Fig. 1 are seen to be essentially similar in nature, as is to be expected, and it seems reasonable to consider that their average will be fairly representative of our battleships. When using this average curve for a ship not yet

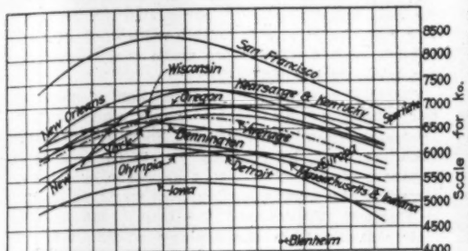


Fig. 3. Coal Coefficients for Various Vessels.

tried, it is necessary to have an I. HP. curve for the latter. I have estimated the I. HP. curves for a number of classes of our ships and thus prepared Fig. 2, which shows the endurances of the ships in question, estimated by the method outlined above. The assumed bunker capacity, upon which endurance is based, is indicated in each case. In the case of the "Maine," an actual curve of I. HP. was available, but she has not yet been long enough in commission to supply a reliable average coal consumption curve, so in her case the actual curve of I. HP. was used instead of an estimated one.

The above method will undoubtedly give results reasonably near the average for ships of the same general type and with machinery reasonably similar to that of the ships used in obtaining the average coal consumption curve. It has the objection for design purposes of requiring the I. HP. curve to be estimated, while we frequently want to estimate the endurance of a design before the I. HP. curve or maximum speed and power are settled.

It appears desirable, then, to develop some other method of approximating to endurance. Now, for naval vessels the endurance at about 10 knots is reasonably close to the maximum endurance in any case. At such speeds the resistance of these vessels is nearly all frictional and proportional to the wetted surface. The wetted surface is closely proportional to the square root of the displacement multiplied by the length. Let D denote displacement in tons and L the water line length in feet. If then the resistance at 10 knots varies as the wetted surface, it varies as $\sqrt{DL}$, and the effective power is proportional to the same quantity. If then the coal consumption at a given moderate speed is proportional to the effective power it will be proportional to the wetted surface, or to $\sqrt{DL}$. Let m denote the miles made per ton of coal consumed, and C the coal consumed

Coal Consumption of English Naval Vessels, tested in 1903.

Name of Ship.	Type of Ship.	Length, Ft.	Displacement, Tons.	—30 Hour trial.— 20% Power. I. H. P.	Coal consumption, lbs.	—30 hour trial.— 70% power. I. H. P.	Coal consumption, lbs.	—Full power.— I. H. P.	Coal consumption, lbs.
Duncan	Battleship	405	14,000	3,755	2.05	13,717	1.90	18,222	1.95
Russell	"	"	"	3,767	2.4	13,685	2.14	18,199	2.10
Montagu	"	"	"	3,676	2.21	13,852	1.78	18,113	2.22
Exmouth	"	"	"	3,667	2.18	13,774	1.95	18,285	2.117
Cornwallis	"	"	"	3,724	1.96	13,687	2.09	18,201	1.89
Albemarle	"	"	"	3,606	2.26	13,576	2.11	18,301	1.96
Average of Duncan Class				3,699	2.18	13,682	2.00	18,220	2.04
Queen	Battleship	400	15,000	3,058	1.84	11,870	1.61	15,556	1.76
Pr. of Wales	"	"	"	3,128	2.21	11,669	2.08	15,364	2.02
Monmouth	1st cl. cruiser	440	9,800	4,711	1.83	16,326	1.45	22,189	1.97
Essex	"	"	"	4,642	2.03	16,132	2.17	22,219	2.22
Lancaster	"	"	"	4,643	2.1	16,044	2.16	22,881	1.94
Suffolk	"	"	"	4,354	1.89	16,350	1.89	22,645	2.2
Euryalus	"	"	"	4,780	1.99	16,510	2.22	21,302	1.98
Clio	Sloop	185	1,070	311	2.32	1,041	1.94	1,435	2.03
Challenger	2d Cl. Cruiser	355	5,880	2,636	1.745	8,972	1.74	12,781	1.78

per day in tons. Let k denote a coal consumption coefficient. Then $C = k\sqrt{DL}$. If V denotes the speed in knots, then $m = \frac{24\,V}{C} = \frac{24\,V}{k\sqrt{DL}}$.

Both m and k are readily calculated if a curve of coal consumption per day in tons plotted over speed is available.

Let us write $k_o = \frac{24\,V}{k} = \frac{24\,V\sqrt{DL}}{C} = m\sqrt{DL}$.

Then $m = \frac{k_o}{\sqrt{DL}}$. Now, the coal coefficient, k_o, should be semi-constant, i. e., it should not vary much on a given ship throughout the range of moderate speeds and should not vary much in passing from ship to ship. If at the moderate speeds to which the above method is applicable the whole resistance were that due to friction of the wetted surface only, and if all ships had at these moderate speeds the same coal consumption per I. HP., and the same efficiency of propulsion, then one curve of k_o would apply to all ships.

We know that the above suppositions are not correct. The only method of determining whether they are sufficiently close approximations to the facts to be of practical value is by investigation of actual results. Fig. 3 shows the curves of k_o for a number of naval vessels as obtained from their average curves of coal consumption under all conditions. Using the average curve of k_o shown in Fig. 3, we obtain the estimated endurance for a number of naval vessels which are plotted in Fig. 4. The assumed bunker capacities for Fig. 4 are the same as used in obtaining Fig. 2. Fig. 4 should be compared with Fig. 2, which shows the estimated endurances of the same vessels obtained by the method first described.

It is seen that the results of Fig. 4 and Fig. 2 differ a good deal in some cases, but when we see in Fig. 3 the wide difference of endurance between the "Massachusetts" and her sister ship, the "Oregon," the endurances in question being the average results of a number of years' experience under all sorts of conditions, it is evident that we cannot expect any formula to give a very close approximation in practice, since any possible formula or approximate method to be applied before the ships were built would necessarily give the "Massachusetts" and the "Oregon" the same endurance. Some of the discrepancies between Figs. 4 and 2 are, however, susceptible of qualitative explanation. Generally speaking, it is seen that in Fig. 2 the endurances of the vessels of moderate power are much greater than in Fig. 4, while those of the higher-power vessels are less. The methods used in obtaining Fig. 4 take no account of the amount of power originally installed, and as the average curve of k_o obtained in Fig. 3 is the result of experience with moderate-powered vessels rather than high-powered vessels, it is very evident that in Fig. 4 the endurances of the high-powered vessels are overestimated.

Suppose we have two similar vessels, A and B, which require 1,500 effective horse power to drive them at 10 knots, and suppose, moreover, that in vessel A the maximum power of the engines is 20,000, while in vessel B it is only 5,000. Suppose that the machinery in each case is of the same general type. Evidently, then, vessel B at 10 knots will waste very much less power in friction of machinery than vessel A, which has machinery capable of developing four times the power of B. Hence, the indicated horse power required to drive vessel B at 10 knots will be less than that required to drive vessel A. Moreover, vessel B will be working at a fairly large fraction of her maximum power, and hence her engines will be working under economical conditions, requiring nearly their minimum of coal per I. HP. per hour. Vessel A, however, will be working at a very small fraction of her maximum power, and not only will she require more indicated horse power than vessel B, but each horse power per hour will require much more coal. Hence, the coal consumption of A must be materially greater than that of B.

The methods used to produce Fig. 2 take some account of these conditions, while those used for Fig. 4 ignored them and would give vessels A and B the same endurance at 10 knots, regardless of the maximum capacity of their engines. Thus, the methods used for producing Fig. 2 are essentially more accurate than those used to obtain Fig. 4. I do not consider, however, that they are of much more value in practice. They require more data, and if we follow the wetted surface method, and, instead of always using the same coal coefficient, k_o, choose a coefficient with discretion to suit the type of ship, we ought to obtain satisfactory results.

It may be of interest to supplement Fig. 3 with some data regarding 10-knot merchant ships. The wetted surface method should be applied with some caution to them, because, being designed for moderate speed only, their residuary resistance other than that due to skin friction generally forms a larger proportion of the whole than for men-of-war at moderate speeds. Taking the consumption used for propelling the ship only, a large 10-knot freighter with some passenger accommodation gave the results below upon four consecutive Atlantic passages. It happened that two of these were when loaded to a displacement of about 18,000 tons, and two were when light at a displacement of about 9,000 tons:

Passage No. 1, loaded, $k_o = 11{,}060$.
" " 2, light, $k_o = 12{,}010$.
" " 3, loaded, $k_o = 12{,}630$.
" " 4, light, $k_o = 8{,}830$.

The first three passages were made under moderate weather conditions, although rather

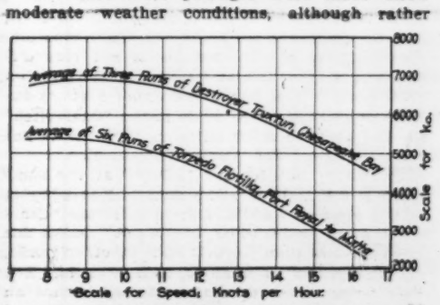

Average of Three Runs of Destroyer Tiverton, Greatest Speed Ever
Average of Six Runs of Torpedo Flotilla, Fleet Record for Month
Scale for Speed, Knots per Hour.
Scale for ko.

Fig. 5. Coal Coefficients of Torpedo Vessels.

more stormy than ordinary fair weather at sea. The last passage was made in exceptionally heavy weather throughout, gales blowing almost without intermission, and it is seen that there is a big reduction in the endurance.

Another instance is that of the naval collier "Lebanon," at about 3,100 tons displacement, which during the run from Baltimore to Colon, 2,000 miles, at a 9-knot speed, showed an average value of k_o of 12,450.

The large collier "Ajax," of about 9,000 tons displacement, during a run of 11,700 miles, from Hampton Roads to Manila, at about 10 knots speed, showed an average value of k_o of 12,900. The "Lebanon" and "Ajax" trips were both fair weather trips.

Fig. 5 shows a curve of k_o for one of our destroyers when tried especially for endurance. It shows also an average curve of k_o for five destroyers as deduced during the first portion of the run of the flotilla of five to Manila. The wide difference between the curves is characteristic of the difference between special trials and average service results, although it is possible that it is partly due to superior design in the case of the single destroyer. Even for these destroyers it is seen that the most economical speed does not rise above 10 knots. There is a natural tendency for the economical speed to be higher for high-powered vessels than for low-powered vessels. This is because the relative waste by friction of machinery is less as we increase speed and power. The less the friction of the machinery, however, the lower the economical speed, and the fact that this does not exceed 10 knots for any of our vessels for which we have reliable coal consumption data is indirect evidence of the smooth running qualities of their machinery.

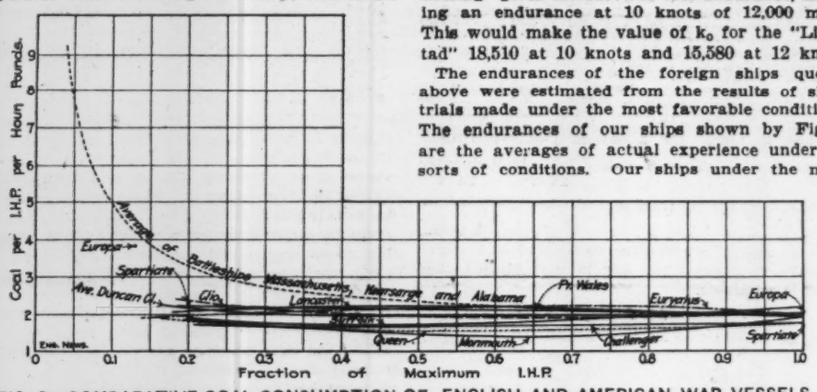


FIG. 6. COMPARATIVE COAL CONSUMPTION OF ENGLISH AND AMERICAN WAR VESSELS.

What I have said hitherto applies entirely to United States vessels. Anyone familiar with the coal endurances ascribed to foreign men-of-war will have noticed that the actual and estimated endurances of our ships are decidedly below those frequently credited to foreign vessels. For instance, "Le Yacht," of Sept. 12, 1903, in describing the new Russian battleship "Czarevitch," says:

> Radius of action: At normal load the ship can carry 800 tons of coal, but the total capacity of bunkers will permit her to take about 1,350 tons, which will give her a radius of action of 5,500 miles at 10 knots. This theoretical radius of action will find itself sensibly increased in practice by reason of the very small consumption of coal, which on trials was only 1.33 lbs. at 12 knots, with 3,640 HP., and 1.72 lbs. at more than 18 knots, with 15,800 HP.

The "Czarevitch" is 389 ft. long, of 26 ft. draft, 76.1 ft. beam, and of 12,960 (English) tons displacement. It is seen that she is not very different from the "Maine," and the "Maine" on 1,800 tons of coal has a maximum average endurance of 5,220 miles, while to the "Czarevitch" we find ascribed 5,500 miles on 1,360 tons. The value of k_o for the "Czarevitch" at 12 knots is 9,150, while that for the "Maine" at the same speed is 6,452. It is to be remarked in addition that it requires 3,640 I. HP. to drive the "Czarevitch at 12 knots, while the "Maine" makes this speed for less than 3,000 I. HP. In other words, the "Czarevitch" at 12 knots, with more than 20% more horse power than the "Maine," claims an endurance per ton some 40% greater than that of the "Maine." It should be pointed out, however, that the estimated endurance of the "Czarevitch" is based upon trials under the most favorable conditions.

Another instance is that of the Chilian battleship "Libertad," built by the Vickers-Maxim Co., now the English "Triumph." London "Engineering" of Dec. 11, 1903, in describing this vessel, made the following statement:

> The next fighting quality of interest is that of coal capacity, and the trials afforded interesting data on this question. The "Libertad" can take 2,000 tons, and it was found that steaming at 12 knots necessitated a consumption of about 1¾ tons per hour; at 15 knots, 3½ tons per hour; at 17¼ knots, about 6¼ tons per hour; and at 20 knots, about 11 tons—all of them satisfactory results for a battleship with such fighting qualities. This consumption, of course, includes that required for all purposes. It will thus be seen that the vessel could steam for 8,600 miles easily at a speed of about 15 knots, which, for most purposes, is quite sufficient;

and again in its number of Jan. 15, 1904, "Engineering" gives the curve of coal endurance, showing an endurance at 10 knots of 12,000 miles. This would make the value of k_o for the "Libertad" 18,510 at 10 knots and 15,580 at 12 knots.

The endurances of the foreign ships quoted above were estimated from the results of short trials made under the most favorable conditions. The endurances of our ships shown by Fig. 3 are the averages of actual experience under all sorts of conditions. Our ships under the most favorable conditions would materially exceed the endurance of Fig. 3, but then again, under the most unfavorable conditions, are liable to fall short of them. After making all allowances, however, the differences between the results of our experience and some results credited to foreign ships are so great as to render it evident that the latter are inaccurate or that coal economy needs to be looked after much more sharply in our service than has been the case hitherto.

In this connection attention may be called to some results recently obtained in service on English vessels. Two Belleville boilered ships, the "Spartiate" and the "Europa," were sent to China at economical speeds, the distance steamed being about 9,600 miles. These are sister ships as regards dimensions, which are as follows: Length, 435 ft.; beam, 69 ft.; mean draught, 27.5 ft.; displacement, 11,000 tons. Some time before the same voyage was made by the protected cruiser "Blenheim" (Scotch boilers), whose dimensions are as follows: Length, 375 ft.; beam, 65 ft.; mean draught, 27.5 ft.; displacement, 9,000 tons. Sir William White has stated regarding the trip of these vessels:

> On the voyage out the "Spartiate" averaged 12.65 knots, steaming easily and developing less than 30% of her full power. Her average coal consumption for all purposes was 2.29 lbs. per indicated horse-power per hour. The "Europa" was sent out at a still lower power—about 13% of the maximum, the average speed being 10¾ knots. Her consumption was therefore higher, namely, 3.85 lbs. per horse-power hour, and she burnt on the passage nearly 700 tons more than the "Spartiate." This demonstrated the fact, previously well understood, that for covering distance the higher speed was more economical in a ship of the type with great engine power. But the most interesting fact remains to be stated: The "Spartiate" burnt nearly 1,200 tons less on the voyage than the "Blenheim" did on the same voyage, the latter being 2,000 tons smaller in displacement, and having cylindrical boilers. The "Europa" burnt nearly 500 tons less.

The actual coal consumptions for the 9,600 miles were very approximately as follows: "Spartiate," 3,000 tons; "Europa," 13,700 tons, and "Blenheim," 4,200 tons. In the case of the "Blenheim" this experience sheds some light on actual endurance as contrasted with paper endurance. Jane's "All the World's Fighting Ships" credits the "Blake" and "Blenheim" with an endurance of about 9,000 miles on 1,800 tons at 10 knots. As a matter of fact, on the voyage to China, which was made at low speed, the "Blenheim" showed an endurance of 9,600 miles on 4,200 tons, or only 46% of the paper endurance with which she is credited. Of course, this is a single voyage and the "Blenheim" might show better results at other times. In order to compare the actual results of these three ships with our experience, I have spotted on Fig. 3 the values of k_o for the "Spartiate," "Europa" and Blenheim" on the voyage to China. The exact speed of the "Blenheim" not being known, I put it down at 10 knots. After making allowance for the fact that the "Spartiate" and "Europa" trips were made with a special view toward economy of coal, I think it will be conceded that if the "Spartiate," "Europa" and "Blenheim" experience is fairly representative of English vessels the ordinary average results of our vessels in practice compare very favorably with them.

It is the practice in the English service to determine coal consumption of new vessels at maximum power with forced draught, at about two-thirds maximum power and at about one-fifth maximum power.

"Engineering" of Jan. 1, 1904, published a number of results for the most recent English ships tried during 1903. These I have tabulated in the table herewith, and in Fig. 6 I have plotted these results over fractions of the maximum I. H. P. obtained in each case. I have also shown by a dotted curve the average consumption of Fig. 1 obtained from our battleship experience, and shown the spots giving the consumption of the "Spartiate" and the "Europa" on their voyage to China. There was no information as to a similar spot for the "Blenheim," but it would undoubtedly have been well above the spot for the "Europa."

The dotted curve of Fig. 6 represents the average of our experience with three battleships, under all sorts of conditions, with all sorts of coal and when using large amounts of coal for distilling, lighting, heating and mechanical ventilation. It is not likely that during the coal consumption trials of the English vessels, when, of course the best quality of coal was used, there was any appreciable expenditure of it for distilling, heating or mechanical ventilation, and, after giving due consideration to the essentially different circumstances, I think it will be admitted that the coal consumption of our earlier battleships does not compare unfavorably with that of the English vessels which were given coal consumption trials during 1903.

Valuable data on coal consumption of modern war vessels is contained in a paper read about a year ago before the Japanese Society of Naval Architects, etc., by the Engineer in Chief of the Japanese Navy. This paper gave the coal consumption of a number of Japanese warships (built in England, France and the United States) on their voyages from the country where built to Japan. These voyages were made at low speeds and were from ten to twelve thousand miles long, except in the case of the Chitose, built in San Francisco. In Fig. 7 I show a comparison between this Japanese experience, our experience, and the English "Spartiate," "Europa" and "Blenheim" experience. It is seen that, broadly speaking, the results from the three nations show remarkably close agreement. The best results, the worst results, and the average results of the several nations are in substantial agreement.

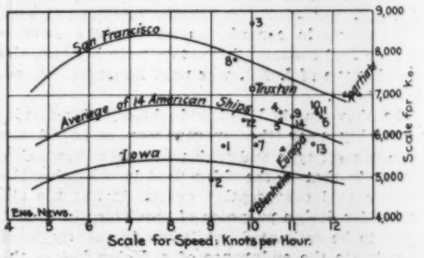


Fig. 7. Comparison of Coal Endurance of American, English and Japanese Naval Vessels.

JAPANESE SHIPS.

No.	Name.	Type.	Date of launch.	Length, P.P.S., ft.	Displacement, tons.
1.	"Shikishima"	B.S.	1898.	400	14,850
2.	"Asahi"	B.S.	1899.	400	15,200
3.	"Mikasa"	B.S.	1900.	400	15,120
4.	"Yakumo"	A.C.	1899.	409	9,646
5.	"Azuma"	A.C.	1899.	445	9,307
6.	"Iwate"	A.C.	1899.	409	9,750
7.	"Idzumo"	A.C.	1900.	409	9,750
8.	"Fuji"	B.S.	1896.	374	12,450
9.	"Yashima"	B.S.	1896.	374	12,450
10.	"Asama"	A.C.	1898.	408	9,700
11.	"Tokiwa"	A.C.	1898.	408	9,700
12.	"Takasagi"	C.	1897.	360	4,160
13.	"Kasagi"	C.	1898.	375	4,900
14.	"Chitose"	C.	1898.	377	4,760

COAL FACTOR. k_o

m = miles per ton of coal;
D = displacement, in tons;
L = length, in feet.

$$k_o = m \sqrt{D} \cdot L$$

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ADVERTISING RATES will be furnished upon application. "Want" and "For Sale" notices (special rates), see pages 26-27. The pages for new "Want" "Proposal" and "For Sale" advertisements are held open until Wednesday noon.

The most notable example of the private ownership of water-works on record ceased to exist on June 23, when the eight water companies supplying metropolitan London transferred their works to the Metropolitan Water Board. The total price to be paid by the new board for the works has not been fully determined, owing to certain appeals by the companies from the decisions of the arbitrators to the House of Lords. The aggregate of the amounts originally claimed by the companies was £50,000,000, or $243,000,000. Some of the claims were cut more than in half, even supposing that the companies win on their appeal. Mr. William B. Bryan, Chief Engineer of the East London Water-Works Co., has been selected by the Metropolitan Water Board as its chief engineer. American engineers will be interested to know that he is to be paid an equivalent of £3,750 a year, or a little more than $18,000 a year, for his services, but he will soon give up the private practice carried on while he was chief engineer of the company. Some idea of the importance of these combined works may be given by stating that nearly all the water supplied to some 5,000,000 people is filtered and all of it is pumped, while the operating expenses from June 24 to Sept. 30, 1904, have been estimated at about $600,000.

The transfer of these London water companies concludes a long and sometimes bitter agitation for public ownership at London. That great aggregate of population was one of the relatively few large cities or districts where private ownership of the water-works still prevailed. Every year the number of privately-owned water-works is decreasing, but this is by far the most notable change in ownership which has ever taken place.

The fire risk which constitutes the most imminent danger to the modern fireproof building is the burning of adjacent combustible structures. This risk is called the exposure hazard by insurance engineers. With this hazard eliminated, the development of a conflagration, or even a fire of moderately large proportions, would be impossible. It is quite idle, of course, to talk of eliminating the exposure hazard for years to come. As our cities are now built up, inflammable structure exists adjacent to fire-resisting buildings of steel and masonry, and the immediate problem to be solved is how to protect the good structure from its dangerous neighbors while the march of improvements is gradually correcting their dangerous qualities. In view of this fact, we give space in another column of this issue to a discussion by Mr. John R. Freeman, M. Am. Soc. C. E., of the efficiency of shutters and other devices for protecting buildings against exposure fires. In his discussion, Mr. Freeman considers various forms of shutters, the use of wire glass, and the so-called water curtain or outside sprinkler system. Regarding the present underwriters' standard shutter of wood covered with tinned sheet steel, Mr. Freeman concludes that, while the heat of any ordinary fire is not likely to be great enough to fuse or burn the steel covering, the wood filling may be readily charred and destroyed by temperatures that prevail in severe fires. In this opinion Mr. Freeman is by no means alone. In the discussion which followed the report of the Committee on Devices and Materials at the 1904 meeting of the National Fire Protection Association, important evidence was presented showing that in hot fires metal-covered wooden shutters frequently failed, both because the wood charred and destroyed the strength of the shutter and because the generation of gases from the charring wood bulged and burst open the metal envelope. The suggestion is made by Mr. Freeman that the solution of the shutter problem lies in the use of solid steel plate shutters applied to the inside of the windows. If these shutters are made without ribs and with provisions for expansion he believes that they will not warp. One of the chief merits of this suggestion is that it does away with the objection of the unsightliness of outside shutters, and permits of the protection of the windows facing the streets as well as those facing adjoining property. The remarks made by Mr. Freeman on the merits and demerits of wire glass and water curtains are particularly interesting. The water curtain in particular has received a great amount of injudicious commendation as a fire stop, and it is refreshing to find so prominent an authority frankly discrediting its value for this purpose. In closing we may express the hope that Mr. Freeman's suggestion that the steel plate shutter shall be subjected to careful tests will be carried out. The National Fire Protection Association have already an excellent testing plant for such purposes, and it may be expected, we think, that another year will give insurance engineers a number of important test records from this plant.

A practical trial of the use of copper sulphate to rid a water-works reservoir of algae was made at Elmira, N. Y., the latter part of June, and is described elsewhere in this issue. So far as we know, this is the first time the method has been given a practical trial, since it was formerly announced by Messrs. Moore and Kellarman in a bulletin of the U. S. Department of Agriculture, lengthy extracts from which were published in our issue of May 26. The bulletin reported a successful use of the method on an unnamed water-works reservoir in Kentucky and on water cress beds at Ben, Va. Judging from the statements made by Mr. Caird in his article elsewhere in this issue, the process was eminently successful at Elmira. The cost for the chemical agent was relatively low, and that for the use of 1 1-3 parts of copper sulphate per 1,000,000 gallons of water treated, as compared with 0.25 parts for the reservoir treated in Kentucky. The labor cost of application was only that involved in employing two men and a boat for less than eight hours. A strictly accurate accounting would probably include a small sum for freight, or cartage, but including all proper charges, it is not likely that the cost would exceed 65 to 75 cts. per 1,000,000 gallons of water treated. Obviously, however, a number of trials, under varying conditions, are needed to determine the actual cost. Should it be found, a possibility mentioned in our issue of May 26, that some agent is necessary to nullify the effects of the copper sulphate before the water treated with it is safe or desirable for consumption, the cost would, of course, be increased accordingly. There appears to be no indication, thus far, that a counter agent will be required, unless the killing of fish, reported by Mr. Caird, be considered as such. It should be noted that the treatment at Elmira is credited with a very material reduction in the bacterial contents of the water, and also in the frequency of washing the filters and the amount of wash water required. The latter, of course, relates to frequency of washing since the growth of algae were checked. If similar results can be relied on wherever the copper sulphate is applied to a water subjected to filtration, the process will be doubly welcome, and its net cost will be less than that already indicated.

Before leaving this subject we wish to record an incident which occurred some years ago, and to inquire of any one competent to answer whether it is merely a coincidence. Several visits were made to a member of our editorial staff, perhaps five years ago, by an old gentleman who announced that he had a method for preventing algae growths, or what he termed "water sickness." He described himself as an "analytic and synthetic chemist," and his expression of ideas was not altogether coherent. These facts, combined with a most vigorous general denouncement of scientists who, he said, had been falsely claiming to know all about the cause and prevention of trouble from algae, and particular accusations against the Massachusetts State Board of Health and a few well-known miscroscopists, lead us to look with incredulity upon this gentleman's claims for an algae remedy. Our incredulity was heightened by the air of mystery in which his method of treatment was involved. Curiously enough, however, particularly in the light of the means now being employed to apply copper sulphate to water-works reservoirs, this gentleman would only say of his own mode of treatment that it was so simple that it could be applied by any one who could row a boat. Is this a mere coincidence or has the copper sulphate method of algae prevention been known and secretly guarded for years?

Steel bridge construction differs so radically in its nature from the earlier forms of structural art, that the development of a new basis of aesthetic design to suit the new material was inevitable. In the earlier years of iron bridges this was, perhaps, not so fully appreciated. Unthinkingly, many assumed that aesthetic effect was contingent upon a forced adaptation of iron truss and girder work to old-established standards of stone and timber architecture. Even to-day the popular mind often makes a direct comparison between stone and iron bridges, setting them against each other detail by detail. Among engineers themselves, phrases such as "the inherently greater beauty of the arch" have some currency.

Reinforced concrete offers another example of the necessity for developing new aesthetic tenets to suit new natural conditions. This particular case is the more interesting because the formation of the new standards is not yet completed, is even hardly under way! Moreover, the example of reinforced concrete illustrates well the difficulty of making a *conscious* analysis of the foundations on which to develop such new artistic standards. For, the material is not so far removed from the material on which all classic architecture is based —stone—as is steel; while on the one hand it simulates steel in its constructive adaptability to certain uses, yet on the other hand it simulates the more venerable masonry in its appearance and in some of its constructional properties. Concessions must be made by this material of mixed characteristics; it must be applied and formed not only with due regard to all its intrinsic constructional characteristics, but also with proper deference to its artistic relations with stone. What success has been achieved hitherto in this aim has been perhaps in few cases the result of conscious effort, but in most cases the product of unconscious aesthetic perception. This, it is worth noting, has come about with little or no aid from the student of aesthetic construction, the architect; it has been accomplished by the engineer unaided.

We are led to these reflections by the juxtaposition of the designs for the new Manhattan Bridge in New York City, published in our last issue, and those for a German bridge of some magnitude of which we present a sketch in another column. Both designs, of radically different

type, were worked out by structural engineers with the assistance of architects, who were charged with ensuring adequate aesthetic effect in the completed design. Both designs, moreover, are, in our opinion, quite successful, when judged as a whole. The interesting thing about the two designs is that they are products of two radically different paths of development in steel bridge design.

American bridge construction has been developed by the engineer alone, without reference or concession to the representatives of aesthetics or ornamentation. This does not mean that designers have not aimed at pleasing appearance, or that they recklessly produced ugly designs, but merely that they worked without the assistance of architects or others trained in artistic construction. In Germany, on the contrary, few large bridges have been designed without the cooperation of architects or sculptors. In every large structure the conscious effort was made to attain positive beauty, monumental or decorative effect, and the like. When the engineer had completed his plans, the representative of plastic art set to work, adding portals, decorative panels, grille-work, relief sculpture and statuary, etc., etc., in order that the landscape might not be marred by a bare skeleton of trusswork. The results of this method of development, exemplified in the typical appearance of German bridges, often illustrated in our columns, are no doubt satisfying to the country of their birth, but they are not accepted with unanimous approval in America. On the other hand, of course, the plain undecorated truss bridge, characteristic of America, may meet severe aesthetic criticism in Germany. Even in our country prominent voices are sometimes heard arguing for ornamentation to relieve the plainness of our bridges.

In the two bridges here referred to, we may notice a tendency toward agreement between the two courses of practice. The American designers called upon an architect for assistance in reaching the best aesthetic effect; the German designer and architect have contented themselves with an unusually restricted amount of decorative addition. Yet the fundamental difference in point of view is apparent. The American design contents itself with bringing into relief the necessary elements of the bridge, as is so well explained in the letter of Carrère & Hastings, published in our last issue. The items of apparently purely decorative value (the peristyle over the anchorages, for example) are, in intention, merely devices to aid in securing this relief. In the German design the architectural elements are extraneous: a massive masonry pile at each entrance, quite unnecessary to emphasize any structural or functional element of the bridge, and the turreted roofs over the main towers, which are equally foreign to any utilitarian purpose.

On the whole, the American course of development of bridge design appears the most satisfactory. The plan of viewing iron bridges as decorative monuments has brought forth few, if any, notably happy results, and any exceptions to this statement are cases where an architect of genius has subordinated his decorative instincts to an appreciation of the functional value of the structure, which ordinarily is possessed better by the engineer. The principal part of the aesthetic elaboration—avoiding structural incongruities, such as the juxtaposition of different truss systems, the use of bad proportions of truss or of individual members, etc.—is in any case the work of the engineer. It may (and does) require the artistic sense, since often neither stress sheet nor cost estimate reveals errors in this part of the work, but, none the less, no one but the structural engineer is capable of executing it.

THE NEED OF PROMPT ACTION ON NEW YORK'S ADDITIONAL WATER SUPPLY.

There is one present pressing public need in the City of New York that surpasses all others. It is more important than additional schools, more important than rapid transit facilities, more important by far than new bridges or tunnels, or additional parks. In fact there is no demand on the public treasury at the present time for any purpose whatever that should not yield immediate, unquestioned precedence to the demand for an additional water supply.

The public does not appreciate the situation. Even the intelligent portion of the public fails to comprehend the urgency of the need. The Croton water supply never has failed, and the public seems to have settled down to a blind faith that it never can fail—that so long as wood grows and water runs, water will be available for the household at every faucet, and for the extinguishing of fires at every street hydrant. It is not realized that each faucet and hydrant is dependent on the rainfall upon the hills and valleys of a little tract of country forty miles north of the city, supplemented by storage in artificial reservoirs, and that the contingency of a drought long enough in duration to exhaust the supply in these reservoirs —a contingency liable to occur at any time, would bring upon this great metropolis the almost unimaginable calamity of a water famine.

And what would a water famine mean? We will pass for the minute all the injury to the household, all the sanitary risk in a city of two million people deprived of water for water closets, for flushing sewers and for bathing—and this very likely during the hottest weather of summer—the time when drought is most likely to occur. Let up pass all this and ask the question what will it mean to the City of New York if a drought this summer or next summer or at any time in the next five years cuts off the supply to the fire hydrants? What can New York's fire department do under such circumstances but look on in impotence while fires grow into conflagrations and sweep their way unchecked? We have no desire to pose as alarmists. Everybody knows that daily and often hourly fires are occurring in some part of Manhattan Island and are extinguished by the prompt work of the fire department. We ask the simple question where would these fires spread to if they were left unchecked? And if the Croton water supply were cut off they would have to be left unchecked, except where the fire boats could reach.

This matter is far from being a purely local one, but it concerns the nation as a whole. If such a state of affairs as we have sketched came to pass, the insurance companies of the world would cancel their policies on New York property; but even then to have the commercial and financial metropolis of America given over to the devastation of conflagration might easily sweep the whole nation into financial disaster.

Have we overdrawn the situation? Have we in any sense magnified the urgency of the need for prompt action? If the critical reader holds such an opinion we invite his attention to the testimony of a witness whose authority is beyond question. This witness is Mr. John R. Freeman, who has been connected in the most intimate way with the New York City water supply situation for four years past, and was a member of the engineering commission which conducted the investigation for an additional supply a year ago. On May 12 last Mr. Freeman was a guest at the annual banquet of the National Board of Fire Underwriters and there lies before us a printed copy of the speech which he delivered there. To anyone who thinks that we have overestimated the gravity of the situation we invite attention to the following excerpt from Mr. Freeman's remarks:

The New York water supply is a matter about which the interest of underwriters has not yet been sufficiently aroused.

Four years ago, I came over here suddenly in response to a telegram from the head of the Finance Department, when everybody was so thoroughly stirred up about the Ramapo matter, and Mr. Coler met me at the train, and said that he understood I had had some experience in water supply in a large way in Boston, and he wanted me to take hold of this question here in New York.

I never worked in my life as I did for the eight months until I presented my report, and in making that report, the more I worked the more I became aroused to the great and immediate need of the City of New York for an increased water supply. That was four years ago, and the first shovelful has not yet been turned on the construction of the new supply.

I had never realized until I got well along in that investigation how near you came to the ragged edge of a fearful disaster in 1891, and very few New Yorkers realize this condition to-day. As I platted the curve of the lowering of the reservoirs in November, 1891, I found it going down from day to day, until one reservoir after another was empty, until there was only 48 hours supply for the great City of New York in its reservoirs. I went to Mr. Fteley, one of the finest men who ever lived, the late Chief Engineer of the Croton Aqueduct, and said to him, "Mr. Fteley, did you recognize this?" "Certainly," he said, "I realized it so thoroughly that I had engaged quarters for my family outside the city and was planning to move them away, out of the impending disaster on the same day that the rain happened to come."

Two more days and the supply of New York City would have been cut from two hundred million gallons a day down to less than fifty million gallons a day! What would that have meant to insurance interests? What to the business interests? What to the public health?

The public did not know that. How many of the merchants and underwriters realized that at one time the gates on all of the 4-ft. mains leading out from your Central Park reservoirs had been shut down little by little day after day, trying to choke off the pressure and to thus check the consumption of water, until those 48-in. gates were only open an inch and a half at the bottom? Fortune favored you and you came out all right. That is the condition that you are liable to come to again unless you stir yourselves, and unless your statesmen, public officials, politicians and good citizens generally get a move on in this question of additional water supply.

Since that time there have been new reservoirs built; but the area of the water shed remains the same. Your great reservoir above the new Croton Dam will perhaps be completed next year, adding much to the volume of water stored, but even with that complete you cannot long be safe; the city is growing, consumption is increasing, and in case of an exceedingly dry year coming, such as has several times come in the past, it would only be safe for about five years more.

Now, with all possible diligence you cannot possibly drive the long tunnels needed through the range of mountains that comes down to the Hudson below Peekskill, in less than five years. In other words, do the best you can, and if a dry year happens to come before the new works are built you will be "up against it," and up against it pretty hard.

I have seen a great deal in the papers about your salt-water system, and I cannot refrain from taking this opportunity to say a word about that, because I think that in the popular mind, at least, there is a great misapprehension.

As an engineer, I have been planning systems of fire protection nearly twenty years and have planned a good many salt-water systems, and systems depending on auxiliary pumps, but the lesson that comes over and over again is that in actual fires a gravity system under high pressure is greatly to be preferred to any system depending on pumps that are seldom used, and that these extra high pressures of 250 lbs. to the square inch, or 350 lbs. to the square inch, are not necessary, and in many cases are worse than useless.

The New York Water Supply Commission of last year, of which I had the honor to be a member, gave much attention to this matter of fire protection. From my own experience as an underwriter, the conditions appealed to me with special force, and I pleaded earnestly with my colleagues as to the necessity for improved fire protection in New York.

My colleagues, Prof. W. H. Burr and Mr. Rudolph Hering, and myself, each gave much attention to these important considerations of guaranteeing the great commercial interests of the metropolis of this country against a sweeping conflagration, and we investigated carefully low-service systems and high-service systems, and finally we were unanimous that here in New York the best first addition to the water supply ought to be a high-pressure gravity supply, and so we planned a supply which should come down to the northern end of the city, and be delivered by the force of gravity into a large reservoir that would hold many times the volume of water that has ever been used in the greatest conflagration. That water would be there always, irrespective of pumps or machinery, dependent only on the force of gravity and a pipe line, ready for instant use, available on any hydrant to which the new pipes are run, at a pressure as high as a hoseman can safely handle.

We handed in that report on the first day of last December. We worked with a rush to get the surveys completed, so the work could begin this spring; but nothing more has been done, and no one appears to be so much interested as the urgency of the case demands.

This high-pressure gravity supply of fresh water is, I will say, twenty times as good as any such salt water system as you have planned. A salt water system, under certain conditions, would be all right; but under the conditions in Manhattan and Brooklyn, I make bold to suggest that the energies of an organization like this could be better directed toward trying to get the first-class gravity supply connected to new hydrants, which would give you a very much better pressure than the present Croton, and to pushing forward in any proper and legitimate way the additional domestic supply which the city so greatly needs.

Certainly no word that we can say could add to

the force of the case presented by Mr. Freeman. The question is will the city of New York and its municipal authorities awaken in time to the gravity of the situation. The absolute necessity of an additional water supply to provide for increased consumption is universally realized. It must be built sooner or later, and the revenues from the increased supply will pay a good return on the capital invested to build it. Why not, then, undertake its construction at once and shorten by so much the years during which at every season of drought those in charge of New York's water supply must watch the rapid fall of the water line in the storage reservoirs and calculate the number of days that the supply will last if rain fails to come.

The preliminary work for a new supply has been well and thoroughly done. Engineers of national reputation have thoroughly studied the situation and advised where the new supply may best be obtained. A part of that proposed supply has indeed been cut off by the unfortunate action of the last legislature; but there is no obstruction to prevent the city from proceeding at once with the construction of the great reservoirs in the Esopus valley and the tunnels which must be built to bring water from any of these northern sources to the city. Upon the construction of these tunnels the time necessary for the introduction of any additional supply depends.

FIG. 1. THE HALL CONDUIT CENTERING READY TO RECEIVE THE CONCRETE.

LETTERS TO THE EDITOR.

Questions on Masonry Arch Design.

Sir: It is evident that the thickness of an arch ring of masonry construction is the function of its span, rise and curvature as well as its surcharge and working pressure of the materials which construct arch. But, unfortunately, in many practical formulas, we can not find out the term of surcharge or working pressure—with a few exceptions in German formulas—and we are very much troubled to obtain the thickness in trial, either by calculation or by graphical method under certain assumptions.

If you or your readers will give proper answers to the following questions we will be very much obliged:

(a) Any reliable formula or formulas for finding the thickness of masonry arch at crown and at springing, containing the terms of surcharge, working pressure and others.

(b) Name of any book which fully explains the question.

(c) Practice in constructing arches under high embankment.

Your obedient servant, C. Mogamy.

Yonago Hoki, Japan, June 8, 1904.

Degree of Turnout Curves.

Sir: Referring to the communication of Mr. A. M. Haynes in your issue of June 23 in regard to a common error in calculating the degree of turnout curves, it does not appear to the writer that what Mr. Haynes deduces as the turnout curve is properly speaking the turnout curve, but simply that curve which passes through the heel of the frog, and becomes tangent to the rail opposite the frog when its central angle equals the frog angle.

A turnout has a theoretical curve, which is an imaginary simple curve from the point of frog at which it is tangent, to the rail opposite to which it also is tangent. In common railroad standards, the practical curve is that from the heel of the switch to the toe of the frog, and is always of shorter radius than the former, and in practice this is generally understood to be the turnout curve.

The writer also takes exception to the statement in speaking of the turnout curve, "as in the case of a 'Y' track . . . for convenience should be tangent to the main track." A well managed railroad using No. 10 frogs only on its main line would hardly spare the room and track material for a "Y" layout having legs of 5° -03' curve, but would more probably desire one with 12° or 13° curves springing from the heels of the main line frogs, and these curves if produced would not come tangent to the main track, but to a parallel line some distance on the frog side of it.

If one wishes to confine his calculations to but one curve for each frog, and that curve to be of some odd degree and perhaps inconvenient radius, the scheme outlined by Mr. Haynes may do very well, but these will be of little value for a railroad desiring economical locations of its track connections. C. M. K.

Ogden, Utah, June 28, 1904.

A Suggestion For Public Safety Inspections.

Sir: After such an event as the Iroquois or Slocum fire an investigation usually discloses the fact that laws passed for safe-guarding the lives of the public have not been complied with, and that a condition that made just such a catastrophe possible, if not probable, has thereby been brought about, for which the inspectors and the owners each try to shift the blame.

The editorial article entitled "Concerning the Responsibility of Inspectors" in your issue of June 30, presents the situation very clearly. What are we going to do about it?

I propose: That for all office, store or factory buildings, churches, theaters, bridges, boats or other places open to the public, a form of report that would give sufficient detail, but that could be readily understood by the average reader, should be adopted; that the forms should be filled out and sworn to, and, at certain intervals, published in the daily papers over the signature of the inspector. The report on all buildings of the same character should be grouped together and published at one time.

The effect would probably be that all parties affected would take the same interest in seeing that their report showed up well that banks take in their public reports.

To insure the efficiency of the method, the law should provide that it is a penitentiary offence for an inspector to falsify his report, and that any citizen should have the right to call upon the district attorney to order a special investigation and begin action should he discover any misrepresentations in the published report. If the report showed that any building was not in proper condition, it should be provided that after a certain time a second statement should be made as to whether or not the suitable repairs had been or were being made, and, if nothing was being done, the district attorney should be required to take action against the owners to compel them to comply with the laws.

I believe that the passage of such a law by the various states would result in increased protection to the public and to the progressive business man would bring more patronage. Very truly, P. S. M.

Pittsburg, Pa., July 1, 1904.

The Centering Used in Forming the Conduits on the London Electric Conduit Railways.

Sir: Referring to the recent article in your issue of April 21 on the Conduit Tramway System in London, I have pleasure in enclosing a photograph and sketch which may be of interest to some of your readers. They illustrate an improved form of mold for the forming of the conduit, by means of which we have been able to produce a much better and truer tube than that hitherto obtained by the use of wooden centering, and at much less cost in the handling of centering and repairs.

FIG. 2. TWO TYPES OF THE HALL CONDUIT CENTERS.

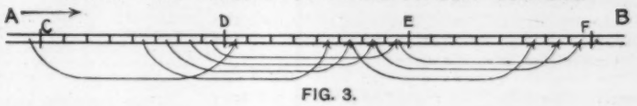

FIG. 3.

Fig. 1 shows the centering in position ready for receiving concrete. Fig. 2 shows two types of centers, one collapsed and one open. Fig. 3 shows how the centers were used without having to be withdrawn from the con-

dult, an operation which is necessary with other centering. Assuming that the length of track A B was being constructed, work proceeding in the direction of the arrow, sufficient forms were placed in position for the length C to D, and the formation of tube was commenced at D and carried back to C, this taking approximately 24 hours, which was the time specified to elapse before centering was drawn. When the tube was completed as far as C, the first length of the centering at D was ready for withdrawal, and was collapsed, drawn through the yokes along the trench as far as E, and placed in position again ready for immediate use. The succeeding lengths from D to C were each collapsed, drawn along the trench and refixed in turn, so that, when the last length at C had been drawn forward to D, the first length at E was again ready for withdrawal and use at F. The centering is designed so that it can be placed in the trench or withdrawn at any point between two yokes; thus the length of conduit constructed in 24 hours may be varied to any required degree. Yours faithfully, J. E. Hall, Engineer.

35 to 39 Hamilton House, Bishopsgate Street Without, London, E. C., May 11, 1904.

(The style of centering shown in Mr. Hall's photographs was also described and illustrated in our article on the London conduit lines, in our issue of April 21. The cut (p. 382) in which were grouped drawings of the earlier wooden centering and this collapsible sheet-iron centering was through error given the title "Wooden Form Used in Concreting the Conduit," which may have misled some of our readers. The text of the article described the new style of form and properly credited its design to Mr. Hall. The views shown herewith give a much clearer idea of the manipulation of these forms than our previous sketch. —Ed.)

A NEW TRANS-ALPINE RAILWAY BETWEEN SWITZERLAND AND ITALY.

By Charles R. King.*

Just when the Italian Government Commission has been inspecting the line already located for the great tunnel which is to reduce the time and cost of transit between Genoa and Milan (Eng. News, March 24, 1904), and after taking local evidence as to its urgency, another project for a new line which would be of considerable interest to Genoa—although much further north—is making progress with the authorities.

This new line is to connect Martigny in Switzerland direct to Turin in Piemonte, Italy. The road would be double-track, worked by electric current derived from power developed by local water falls. From any map it will be seen that such a line would be the shortest between Western Switzerland and Genoa, and that at Martigny (below the Lake of Geneva) it would depend for traffic upon that which was brought up to that point by the Simplon Railway on the line of the Simplon tunnel. Whether such a branch would injure the traffic to pass through the Simplon tunnel, without serving in the opposite direction as a feeder to the other portions of the Simplon Railway affected, it is at present difficult to predict, but the fact, well known locally, that the project has at the back of it a group of wealthy English financiers is evidence that there is ground for considering that the line would prove a profitable one. This line would cost 150 million lires. Its length would be about 157 kilometers. That distance could, if desired, be shortened by curving the line eastward to touch the existing railroad at Aosta—but any such project will not be listened to by the Torinese—for such a deviation to the east of the line proposed would enable the Milanese to run a direct rival line across country to the Aosta line and thus still withdraw some of the international traffic sought for by the Turin authorities. The project has the entire support of the Province of Turin. The counsel of the province has already authorized the preliminary work of investigating the scheme. The resolution it passed in January has since received the approval of the Ministry of Public Works at Rome, and the sanction of the Railway Administration, of the Turin division, is now awaited.

The proposed railway line will labor under excessive difficulties with regard to gradients. Something like a total distance of 60 miles will be graded at 5%, and require two long tunnels, one between Forzo and Cogne, 12,300 m. in length, and another at Colle Gerret, 6,200 m. in length—this last on the dividing line between the two countries. There would be ten short tunnels besides. The elevations attained by the line above sea level would be 1,800 m. on the first mountain—La Vachey— and 1,610 m. on the second mountain —La Cogne. The elevation of valley between the two mountains is 875 m., and the terminals, Martigny, 469 m., and Turin, 236 m. With such grades the proposed line could, it is evident, never serve for a very heavy traffic. For tourist traffic the altitudes reached in close proximity to the Mont Blanc and St. Bernard would be a strong inducement for travelers for the Mediterranean to choose it in preference to the Simplon route. But English capital needs a more substantial prospect for returns than those cited. The development of a region rich in mineral resources has, in fact, much to do with the objects of the line. The principal minerals which can be mined there are iron, sulphates of iron and of copper, manganese, lead and anthracite, and native gold is found at a number of points between Front and Cuorgnè.

If the line is sanctioned, the plants required for the water power and electrical transmission will be the most important in Europe for railways.

At present the water power derived from mountain sources for the working of the Torino street railways and manufacturing establishments of that city is very great, although comparatively insignificant to the innumerable heads of water available throughout the whole region to be traversed by the new lines.

The reader in consulting a map may marvel at this new line being advanced in preference to the one already proposed between Chamonix, France, and Aosta, Italy, the points of separation there being far shorter than from Martigny to Aosta. But the idea of any further connection with the French P. L. M. railroads is repellant to Italians, both countries concerned being protectionist and international customs tariffs always a source of difficulty. On the contrary, connections direct with the free Republic of Helvetia are highly approved, for practical reasons.

*7 Kyffhauser Strasse, Berlin, Germany.

THE TIME REQUIRED TO LOAD WAGONS WITH A STEAM SHOVEL.

By John S. Ely, Assoc. M. Am. Soc. C. E.*

The following notes on steam shovel work may be of interest to engineers and contractors. Wishing to get some data on the subject I made a number of records of the actual work of a 45-ton Bucyrus shovel (1¾ yd. bucket) loading automatic dump wagons, including the time taken by the wagons for the haul, etc. Following is a fair sample of a half-hour run:

Wagon No.	Time when filled.	Wagon No.	Time when filled.
32	2:40 p. m.	98	2:48 p. m.
97		99	
61		89	
91	2:41 p. m.	62	2:49 p. m.
24		64	
15		55	
43	2:42 p. m.	26	
87		93	2:50 p. m.
42		7	
75	2:43 p. m.	38	2:51 p. m.
70		34	2:52 p. m.
47		88	2:54 p. m.
95	2:44 p. m.	32 (2d trip)	2:54½ "
100	2:44¼ "	97	
Shovel moved 5 ft. ahead in ¼-min.; waited 2 mins. for wagons.		46	2:55 p. m.
		61	
		91	

Wagon No.	Time when filed.	Wagon No.	Time when filed.
43	2:56 p. m.	99	3:05 p. m.
15		89	
87	2:57 p. m.	62	3:06 p. m.
42		64	
75		55	
70	2:58 p. m.	26	3:07 p. m.
47		93	
95	2:59 p. m.	7	
100	3:00 p. m.	38	3:08 p. m.
98	3:02 p. m.	34	3:09 p. m.
Short section of track brought ahead; shovel moved 5 ft. in 2 mins.		88	
		32 (3d trip)	3:10 p. m.

From 2:40 p. m. to 2.44½ p. m. the wagons followed one another close together. From 2:50 to 2:54 p. m. the wagons were 150 to 200 ft. apart.

While running steadily the shovel easily filled three wagons per minute. The haul varied from 1,250 to 1,500 ft., making the round trip 2,500 to 3,000 ft., and the average speed of the wagons [illegible] minutes per hundred feet, or 167 ft. per min. The haul was a fair average, being partly up and partly down. In the above run about half the time was spent in waiting for wagons. To find the number of wagons necessary to work the shovel to its full capacity, let L = length of haul (one way) in hundreds of feet; n = number of wagons which shovel can fill in one minute; and t = time of wagon in minutes in going 100 ft; then $N = 2 (n t L) =$ (in this case) 3.6 L or 45 to 54 wagons instead of only 26, as used above. It would not be possible, however, to run a shovel at this rate continuously, and at least 10 minutes per hour should be allowed for moving, resting the men, etc. This would give a rate of 150 loads per hour, or 2½ per min, and make the number of wagons needed 3 L, or three times the haul in hundreds of feet, as shown in the following table.

Haul (one way).	Wagons required.	Haul (one way).	Wagons required.
200 ft.	6	1,000 ft.	30
500 "	15	2,000 "	60
700 "	21		

This, of course, only applies when the wagon is filled with one shovelful. As to the quantity of earth removed, the shovel on the day the above record was taken excavated 1,043 wagon loads, or about 1,200 bank yards; and, although it has never had all the wagons it could serve, owing to lack of teams, the shovel has run as high as 1,200 loads, or about 1,500 bank yards. It should be added that the depth of the cut was 8 ft. and its average width 22 ft., and that it was material easily excavated.

*Assistant Engineer, Torresdale Filters, Holmesburg, Philadelphia, Pa.

A REAR END COLLISION OF EXCURSION TRAINS on the Greenwood Lake Division of the Erie Ry. at Midvale, N. J., on Sunday, July 10, resulted in the death of sixteen passengers. While a special excursion train stood at a water-tank just beyond the Midvale station, a regular Sunday excursion ran into the rear of the standing train. The two rear cars of the forward train were crushed and telescoped. All the killed and injured were in these two cars, and the remaining cars were hardly injured. The train was made up entirely of old, light coaches. The station at Midvale is protected by a manually-operated semaphore signal just back of the station. This signal appears to have been at clear when the collision occurred, either through the fault of the towerman or through some trouble in the signal mechanism.

THE LARGEST STEAMSHIP IN THE WORLD, the "Baltic" of the White Star Line, completed its first trip across the Atlantic on July 7. The vessel is 726 ft. long, and has a gross tonnage of about 24,000. Its loaded displacement is about 40,000 tons. The "Baltic" was built by Harland & Wolff, of Belfast. The engines of the vessel are quadruple expansion, of 13,000 I. HP., and have a speed of about 17 knots. The "Baltic" is twenty feet longer than the next largest Atlantic liner, the "Kaiser Wilhelm II." (Eng. News, Sept. 25, 1902), and registers 3,000 tons more than the "Minnesota" and the "Dakota," the 21,000-ton freight steamers recently built by the Eastern Shipbuilding Co., of New London, Conn., for the Pacific trade. The following table lists the leading ocean steamships of their time as to size and tonnage:

Vessel.	Length. ft.	Breadth. ft. ins.	Depth ft. ins.	Gross Tonnage.
Great Eastern	691	82.8	48 2	18,900
Britannic	468	45.2	33.7	5,000
City of Rome	600	52.3	37	8 100
Alaska	520	50	38	6 400
Etruria	520	57.3	38.2	7,700
Paris	560	63 2	39 2	10 500
Teutonic	582	57 8	39.2	10,000
Fürst Bismarck	520	57.6	38	8,900
La Touraine	540	56	34.6	9,200
Campania	620	65	45	13 000
K. Wilhelm d. Gr.	648	66	43	14,300
Oceanic	704	68	49	17 300
Deutschland	684	67	40 4	16 200
Celtic	700	75	49	20,900
Cedric				
K. Wilhelm II.	706	72	52.5	19,400
*Manchuria	616	65	52	13,300
Mongolia				
*Minnesota	630	73.6	56	21,000
Dakota				
Baltic	726	75	49	23,800

*Built in America.

CASTINGS DIRECT FROM BLAST FURNACE METAL are produced with full success by the firm of Thomas Butlin & Co., of Wellingborough, England, according to a note in "Engineering" (London). That firm is now executing a contract for casting tunnel-lining segments for the Great Northern & Strand Tunnel Ry., at the rate of 100 tons per week.

ENGINEERING LITERATURE

Supplement to ENGINEERING NEWS. New York, July 14, 1904.

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A recently published book, dealing with a matter of some novelty, contains a passage in which the "present" commercial status of the subject-matter is referred to. The passage locates this status in point of time by saying "In June . . .," presumably of the year when the passage was written. Wishing to accurately locate the time referred to, we turned to the title-page, where is usually given the publisher's imprint and a date. This latter proved to be 1904. Since we were then just beginning July of 1904, and some time is required to set up, print, bind and send out a book, we concluded that "June" was not that of 1904. Passing on to the preface for further information (as prefaces are usually signed and dated), we found that the book had no preface, so that this source of information was unavailable. It remained to make a guess, and we guessed 1903 as being as probable as any other year.

The matter at question in this case was relatively trivial. But similar cases sometimes arise, in reading books of exact information, where it is important to know beyond question what date is referred to. Far more often, however, do questions as to date arise in the case of clippings from newspapers and other sources, or in the case of random notes, either one's own notes or those of another. It is aggravating, to put it mildly, when searching for an important item, to find it carefully dated "August 21," without anything except the yellowness of the paper to indicate whether the item belongs to 1892, to 1902, or to some other year. Nearly everyone will recall cases of this kind, and will recall the scrutiny of front and back of paper, of adjoining notes and items, made for the purpose of finding a guiding date. The remedy at once suggests itself: to date all notes or clippings, all written references in papers or books, fully with year, month and day. Even apparently useless repetition in this matter pays well; repeating a date even in a single item should not be too much trouble. For, though at the time of writing a note it may be clear that "February, 1901," and "last January" refer to the same year, this fact may not be equally clear after several months or years have passed.

Another deduction we may draw from our concrete case is that every book should somewhere, either at the end of the preface or at the end of the book, be dated with month and year. Reliance on the title-page date is often misleading.

The references, above, to title-page dates may call for further explanation. Two distinct causes operate to make a title-page date rather uncertain reliance, one cause active in the case of first editions, the other in the case of re-editions. Authors and publishers know, what some among the reading public perhaps do not know, that books are rarely published with as much dispatch as a daily or even a weekly newspaper. In many cases a modified proverb can be applied in substantial justice: "Of the making of a book there is no end." Not always does the author's delivery of manuscript, or even his writing of the preface, fall in the same year as the final issue of a book. Evidently this condition creates a discrepancy between title-page date and the true date of the text. Moreover, cases have occurred, in books issued near the close of a calendar year, where the title-page date was ahead of the actual issue and sale of the book. This, of course, resulted from the desire of the publisher to "keep his book young" as long as possible. It will be apparent, then, that with a delay of less than a year in preparing a book for publication, the title-page imprint may differ from the true date of the text by two years. And the preceding has not considered the author's time of writing the book, the fact that portions may be several years old (and may be left unrevised) before the manuscript is complete. This latter delay, of course, may be indicated by proper note in the preface; or, better, the old portions should be revised and brought up to date when the whole work is complete.

Larger discrepancies between imprint and true date of text sometimes occur in re-editions. It is not always possible to thoroughly revise a book when preparing for a new edition; a new date is placed on the title-page and the new edition is printed off without further ceremony. The title-page date, so much more obtrusive than that subscribed to the preface, is apt to stand for the date of the book. If the preface is absent, or is undated, the book passes under the much more recent date of the new edition. Again, when a new preface is written for an unrevised book, the author does not in all cases mention or duly emphasize the fact that no full revision was carried out, and the date of his new preface will appear to be the characteristic of the book.

Whenever one or more of these causes result in the reader's assigning a wrong date to a book, the loss falls on the author, usually. The reader may be slightly injured by taking old or obsolete information as new, but he is not likely to remain in his error long. Whether he recognizes the fact that the book is somewhat obsolete at once or learns it later, he will in either case charge it to the author as a discredit. The publisher's loss of prestige is less direct, perhaps not sufficiently so to be a very powerful inducement toward accurate dating. But the author has every reason to exercise the greatest care in this direction.

From the library point of view, whether the library be public or private, the "Journal of the Association of Engineering Societies" is a valuable publication, which might be made still more valuable if it received better support from the engineering societies. This support might be in two directions: (1) The enlargement of the membership of the Association and (2) greater promptness on the part of the present membership in sending in for publication the papers read before the various societies. As some, but not all, of our readers are aware, the Association is really a federation of local or semi-local engineering societies for the purpose of bringing together in one publication the most important proceedings of the several federated societies. At present the membership includes eleven societies. The individual members of each society receive the proceedings, or the best of the proceedings, of all the other societies, as well as their own, and that without any direct charge. The advantages and disadvantages, for there are disadvantages, of this plan to the several societies and their respective members, as such, it is not our purpose to discuss. What we wish to emphasize is that in these days of huge and rapidly increasing masses of technical literature any agency that unifies that literature reduces it to orderly form and convenient shape, and provides indexes or other ready means of reference deserves and generally receives a welcome from those who are attempting to keep up a library for the use of themselves or others. Were not the Association of Engineering Societies in existence we should either lack the proceedings of some of the member-societies or else have eleven instead of one set of volumes to preserve, bind, catalogue and keep in order. As a matter of fact, few of us would possess or even have access to the proceedings of more than one or two of these eleven societies. The proceedings of most of the local societies which are not members of the Association are now available to but few outside the membership of the several societies, and, as a rule, such availability as exists is temporary. In other words, it is out of the question for practically any individual and for most libraries to maintain separate files of the proceedings of all the local engineering societies which are not members of the Association. But the Journal of the Association of Engineering Societies would not be too bulky for convenient use if the membership of the Association were materially increased, and, for the reasons indicated, such an increase would be an obvious advantage to public and private libraries.

For many years a notable feature of the Journal discussed in the preceding paragraph was its monthly descriptive index of current engineering literature. When this work was begun by the late Prof. J. B. Johnson no other such index was available. After a few years the monthly entries were combined in a single bound volume, covering the period from 1884 to 1891 inclusive. Later, a second volume was issued, for the years 1892 to 1895, inclusive. These two volumes, and particularly the second one, had the very serious defect of lack of proper arrangement of the entries under the main heads, but even with such a deficiency they were, and still are, very useful. With the close of 1895 the index feature of the Journal was stopped, the reason being that the laborious work involved was no longer necessary, since similar work was being done by a magazine which had assumed the cost of publishing the second volume, and proposed to continue the index. In 1901 a third volume appeared under the title "The Engineering Index: Five Years—1896 to 1900." That volume was a great improvement, in the classification and arrangement, over the preceding ones, and also much larger. In fact, the volume was so large (1,030 pages of small type) as to suggest the desirability of publication at more frequent intervals, and, if we remember rightly, it was reported that thereafter yearly volumes would be issued. We now lack a consolidated index for the three full years, 1901 to 1903, inclusive, and soon another year will be added to these. Yearly volumes would be of great value, provided they did not too long defer the consolidation of several years to make the fourth volume of the series. Obviously, the ideal plan would be to consolidate the references for the three volumes already published, and also for the period since 1900, in one Consolidated Descriptive Index to Engineering

Literature, covering the past twenty-five years or so. This would afford an opportunity to make good the deficiencies of poor arrangement, or lack of arrangement, in the two earlier volumes, besides making possible an entirely new classification, or at least a re-classification, of the first two volumes, to correspond with the third one and with the subsequent monthly entries. If the grand consolidation suggested is not possible as a commercial enterprise it would seem worth while for the engineering societies of America, great and small, national and local, to consider the feasibility of a joint engineering index.

Probably any consolidated index, regardless of the method adopted for its production, should be a classified index, as has been from the start the one already discussed. To produce a purely alphabetical index to engineering literature for 25 years would in some degree defeat the very object of such an undertaking—ease and quickness of reference. A fully classified index at once suggests publication in parts, by topics, but this raises questions of expediency which cannot for the present be discussed. The chief of the questions, however, may be stated in order to lay them before our readers, and also to suggest others for possible discussion in these columns: (1) The greatest good for the greatest number considered, which would be better, a classified index in parts, by such main subjects as electrical, railway and water-works engineering, or simply one consolidated and not so highly classified index? (2) Which plan would be most feasible, financially considered, taking into account the greater cost of an index, in parts, on the one hand, and on the other its possibly greater aggregate sale, as compared with a grand general index? (3) And perhaps this should come first of all: how great is the demand for a classified index covering a longer period than, say, the last ten years? In considering these and other questions bearing upon the whole matter of consolidated indexes, a few facts should be borne in mind: (a) The great lack of the day is not so much printed information on almost any given technical subject as speedy means of locating such information; (b) very few of the engineering journals and society proceedings are provided with consolidated indexes of their own publication. (3) Even if all of them were so provided, the task of looking through so many separate indexes would be so time-consuming and wearisome as to be almost prohibitive. (d) The descriptive entries in the series of existing index volumes under discussion enable the user to reject many references as not suited to his own need of the moment, thus greatly increasing the value of the index and at the same time lessening possible objections to having a grand consolidated index cover more than from five to ten years. Finally, the useless duplication of work and expense in many quarters, combined with the large amount of greatly needed work left undone, makes more and more necessary intelligent co-operation on the part of engineering societies and individual engineers. In the matter of library book cataloguing, the Congressional Library at Washington is already making it possible for every library to save both time and money by ordering catalogue slips from it. In the future, perhaps, a way will be found for that institution to co-operate with our engineering societies in making and keeping up a general classified descriptive index of engineering literature.

CORRESPONDENCE.

Books on Rural Engineering.

Sir: A short time there appeared in Engineering News an article on "Rural Engineering" by Mr. Elwood Mead. Subsequently a letter was published in the Engineering Literature Supplement requesting a list of books best suited for the library of a young engineer.

I would like advice concerning the best books for a small library on Rural Engineering, embracing the following subjects: General engineering; machines, including machinery, tools, threshers, portable engines, sugar mills, etc., that are likely to be used on a large ranch; rural engineering and construction, comprising the general theory and practice of surveying, general construction, roads, bridges, buildings, irrigation, drainage, tramways and light wharves, etc., for use in the development, management and maintenance of a large ranch. I think it would be a good plan if the books selected contained working drawings of at least one of the various things treated. Rural Engineer.

California, June 25, 1904.

(On many of the topics named our correspondent cannot do better than to select from the lists of books for a young civil engineer, published in this Supplement for March 19 and April 16, 1904, in answer to the query mentioned in his letter. So far as we are aware, there are no books, at least no American books, designed for his particular wants, so that he will be compelled to choose from the various branches of technical literature the books best suited to his needs. Suggestions from readers of the Supplement will be welcomed.—Ed.)

The Use of "Shall" and "Will" in Specifications.

Sir: I wish to ask a question concerning the use of "shall" and "will" in specifications. When should one be used rather than the other? The United States Government uses "will" in all orders and communications connected with the Army. Most of the specifications I have seen that have been made by commercial firms use "shall" where a requirement of the specification is meant. When saying that any particular thing is to be furnished by the company for the use of the contractor "will be furnished" is used. The latter use seems to have the sanction of the "Standard Dictionary," but the certainty is all destroyed by saying "In the United States 'shall' is being supplanted by 'will.'" An opinion on the subject would oblige. Yours truly. C. H. Pool.

18 Cortlandt St., New York, July 7, 1904.

(If we correctly understand the foregoing inquiry, the real question involved is one of grammar, and the confusion arises through the popular tendency to misuse the words "shall" and "will" in ordinary conversation. Specifications should comply with the rules for correct writing, therefore "will" in the second or third person denotes simply futurity and "shall" a requirement. In a contract drawn by a city engineer for sewer construction, in which the city states that the cement is to be furnished by it and the brick by the contractor, the specification may read: "All cement will be furnished by the city," and "all brick shall be furnished by the contractor." On the other hand, if a contractor was making a tender he might say the city "shall furnish the cement" and the contractor "will supply the brick." It will be evident that the use of "shall" or "will" frequently becomes a choice between using the language of mutual agreement or of obligation.—Ed.)

Dock Engineering.

A TREATISE ON THE PRINCIPLES AND PRACTICE OF DOCK ENGINEERING.—By Bryson Cunningham, Assoc. M. Inst., C. E., of the Engineer's Department Mersey Docks and Harbor Board. London: Charles Griffin & Co. Philadelphia: J. B. Lippincott & Co. Cloth; 6 × 9 ins.; pp. 559; 34 folding plates and 468 illustrations in the text. $9.

The advent of a treatise on dock construction which could claim to be accurate and complete has been long awaited by engineers. To say that such a treatise has finally been made available in the book before us would perhaps be too high praise, but we at least risk nothing in saying that this book will be a most welcome and valuable addition to the sadly deficient literature in English in harbor construction. The author of the book is a member of the engineer corps of the Mersey Docks and Harbor Board, which since 1858 has administered the dock system of Liverpool, one of the finest under single control in the world. Because his practice has been largely in England the author naturally considers the problem of dock construction from the viewpoint of British and European conditions, particularly when he comes to the consideration of commercial docks, or wet docks, as these are defined by him. In Europe these are almost universally enclosed basins forming areas of impounded water, within which vessels can remain afloat at a uniform level independent of external tidal action. This form of dock is comparatively unknown in America, where the docks are nearly always simple piers and quay walls, partly enclosing and projecting into tidal basins. Because of this difference between dock construction in America and abroad many of the items of dock work considered by the author, for example, such as dock gates and caissons, locks and dock bridges, will have only general interest to American engineers. In the parts of the book which treat of dry docks and floating docks, the engineer here and abroad meets on a more common ground, and much of the matter presented will be pertinent and valuable alike to American and European dock builders.

The book opens with a chapter of historical and discursive character which may be quickly passed over, as the author does not really enter into his technical subject-matter until he reaches Chapter II. This is devoted to general questions of dock design, such as position and outline, the various available forms of docks, ratio of quay space to water area and ratio of periphery to surface. The general discussion of these questions is followed and exemplified by descriptions of the actual dock systems of a number of European ports, including London, Liverpool, Hull, Barry, Glasgow, Hamburg, Havre and Marseilles. These several dock systems are excellently illustrated by maps. The author devotes the third chapter of his book to constructive appliances, and in it he describes pile drivers, steam shovels and dredges, concrete mixers, cranes and various hauling and hoisting devices. In considering these machines the author adopts the somewhat unusual classification of positive appliances and negative appliances, according as the device, like a pile driver, serves to establish structural material in place, or, like a dredge, serves to remove existing material to make room for the dock structures. The machines described and illustrated are, with the single exception of a well-known American gravity concrete mixer, of English design. Chapter IV. considers materials of construction, viz., concrete, iron and steel, timber and stone. Under concrete the author gives at some length the evidence bearing on the action of sea water on concrete, and under iron and steel he considers specifications and the very important questions of corrosion and its prevention. The articles on stone and timber are descriptive in character. The fifth chapter, on dock and quay walls, is of more interest to the American engineer than any that precede it. It may be broadly divided into wall design, methods of construction and examples of failure. Under the first division the author considers first the general questions of stresses, overturning forces and conditions of stability, and, second, the design and construction of foundations. This second discussion is illustrated by examples of foundations at Rotterdam, Limerick, Rouen, Glasgow, Cork and Newcastle. In considering methods of construction the author discusses first ordinary construction in the open, and, second, subaqueous construction, with particular reference to pneumatic caisson work. Failures are discussed by presenting descriptions of typical failures, and pointing out their causes and the remedies adopted. The next chapter in order is that on entrances, passages and locks, and this, with Chapter VIII., on dock gates and caissons, and Chapter X., on dock bridges, while very complete in descriptions of these various structures, contains less of value to American engineers than does Chapter VII. on jetties, wharves and piers. The calculation and construction of these structures is discussed generally, and examples are given of a number of existing works. It is interesting to note in this connection that the author takes ample notice of reinforced concrete as an available structural material for wharves and jetties. Of the remaining chapters, those on transit sheds and warehouses and on dry docks are of particular interest to engineers, the first because of the discussion and examples of fire-resisting construction that are given, and the second because of the increasing number of permanent and floating dry docks that are being built in America as our navy and mercantile marine increase in size.

In closing this brief review of Mr. Cunningham's book mention should be made of the unusual number and value of its illustrations. There are altogether 569 separate figures, and these are almost without exception dimensional drawings of actual structures and details of construction. The book has a fairly good index.

A New Technical Dictionary.

TECHNOLOGICAL AND SCIENTIFIC DICTIONARY.—Containing in Addition to Many Special Articles, Definitions of the Terms Generally Used in Art, Archaeology, Architecture, Assaying, Astronomy, Biology, etc., etc. Edited by G. F. Goodchild and C. F. Tweney. London: George Newnes, Ltd., Southampton St. Part I., A to Bow China. Paper; 7 × 10 ins.; pp. 64; illustrations in the text. To be published monthly in 15 parts at one shilling, net, or 40 cts. a part.

Although marred by some blemishes, this is a very creditable beginning of a small dictionary of technical terms. The blemishes include poor definitions, localisms, and poor English.

A few examples of poor definitions may be cited:

Abutments (Eng., etc.). Surfaces of a structure which support the load, e. g., the top of the piers carrying the girders of a bridge, or the part of the masonry from which the arch springs.

To limit the meaning of abutment to a surface certainly does not accord with engineering usage, in which the term is frequently employed to denote mass rather than surface.

Batter is unhappily defined as "a wall out of perpendicular," but the example cited makes it clear that not the wall but one or more of its sides or faces is out of perpendicular.

A definition that utterly fails to define is as follows:

BACTERIOLOGICAL EXAMINATION OF WATER.—It is recognized that certain zymotic diseases (q. v.) can be produced by a contaminated water supply. These diseases are due to pathogenic bacteria (see bacteria). The presence of these disease-producing organisms can only be determined by bacteriological examination. It is extremely important, therefore, that water should be examined both chemically and bacteriologically.

This is all true and very important, but besides leaving the reader in ignorance of what a bacterial examination of water is, the statements quoted are liable to mislead him into believing that the only object of such examinations is to determine the presence or absence of disease germs, and that such determinations may be readily and positively made.

The localisms, using that term broadly, may be partly justified if the dictionary is designed for use in Great Britain only, but nevertheless they detract greatly from its value in other English-speaking countries. A striking example of these localisms is the definition of "Block System" as "The system of signalling used on English passenger railways."

The poor English consists largely of infelicitous and sometimes ambiguous language, which would not be expected in a work of this character.

The complete work, it is announced, will include about 16,000 entries, of which about 6,000 will relate to the various branches of engineering, 2,000 to the building trades, including plumbing, and 2,000 each to chemistry and physics. Most of the entries are brief, but there are a number of longer, special, signed articles.

COAL IS KING.—By M. C. Huyette, Chicago. Cloth; 6 × 9 ins.; pp. 104; illustrated. $5.

The author states that his intent is to start a line of investigation and education helpful to those who pay the coal bills. After presenting figures to show the economy of coal as compared with oil and natural gas for fuel, the output of coal and the theory of heat are briefly outlined. Uniform size and small size are stated to be requirements for the most economical use of coal in furnaces, and it is suggested that coal operators should install crushers at the mines. A series of tests made at Detroit in 1895 is noted, giving the cost per 1,000 lbs. of water evaporated with different coals and furnaces. Tables of analyses of some 80 different kinds of coal are given, and tables of the chemical analyses and heating values of Illinois coals, the latter accompanying a reprint of a paper by Professors Parr and Koch of the University of Illinois. As to chimneys, the author thinks that more attention should be given to their design:

Ordinarily the cross-section is ample, but not one in a hundred is of proper height to provide the most economical condition in furnace and boiler, and, at the same time, meet the duty required; to equalize matters, grate area is increased, and the fireman must do the rest.

The use of mechanical stokers is recommended, especially where smoke prevention is an object, but it is remarked that with some of these the furnaces will not satisfactorily handle coals which are low in heat value and high in iron and sulphur. Smoke prevention is discussed, and the book closes with some 14 pages of newspaper items pointing to the concentration of coal properties.

The information contained in the book is "scrappy" and unsystematic, and its technical value is slight. In fact, with all extraneous and irrelevant matter excluded, the book would have very slim proportions. The illustrations consist of four plates showing the appearance of samples of coal of different kinds.

THE ECONOMICAL BURNING OF COAL WITHOUT SMOKE.—With Special Reference to the Use of Washed Coal. By A. Bement, M. Am. Soc. M. E., Chicago. Published for private circulation by the Peabody Coal Co., Chicago. Limp cloth; 5½ × 7¾ ins.; pp. 48; illustrated.

This is a brief and practical review of the theory and practice of the burning of coal as a fuel for boilers. The first part deals with heat efficiency, and the losses incident to combustion, together with the subject of incomplete combustion. Under the heading of "Smoke and its Prevention," the author describes what smoke is, under what conditions it is caused, and by what means it may be prevented. These means include special construction of the furnace and the methods of firing. Of the use of steam jets it is remarked that they can be beneficial only to a limited extent, while the cost of the steam used is a direct loss. It is further noted that reliance is often placed on some special style of furnace for smoke prevention, disregarding the fact that the process must be started right at the grate. The use of washed coal is then discussed, and is said to afford the simplest and best remedy for low heat efficiency and for the prevention of smoke with the majority of boilers and furnaces. The washing process is described and its advantages outlined. The last chapter discusses the manipulation of fires and furnaces, both by hand and machine firing.

THE MANUAL OF STATISTICS.—Stock Exchange Handbook, 1904. 26th annual issue. Railroad Securities, Industrial Securities, Government Securities, Stock Exchange Quotations, Mining, Grain and Provisions, Cotton, Money, Bank and Trust Companies. New York: Manual of Statistics Co. Cloth; 5½ × 7¾ ins.; pp. 1,040; maps. $5.

This volume contains the usual mass of facts and figures relating to the railways and industries of the country. The railways alone fill 331 pages of the Manual, while the Industrials occupy 469 pages, and include about 1,000 corporations. In the more statistical part, cotton, produce, cereals, and petroleum quotations are very full. The mining section takes up the fluctuations in mining securities of all kinds, dealt in at the chief exchanges. The bank and trust companies are arranged alphabetically by cities, showing the date of organization, capital, surplus, dividends and range of stock values for 1903.

MANUAL OF CORPORATION SECURITIES.—Fifth Annual Number, 1904. John Moody, Editor. C. L. F. Bridge and Louis W. Holschuh, Associate Editors. New York: Moody Publishing Co. Cloth; 6 × 9 ins; pp. 2,369; folding maps. $10, or in full flexible leather, $12.

The present issue of this reference work follows the same general lines as the earlier ones, but it is larger and more comprehensive. Among the corporations included are steam and electric railways, gas, electric light, water, telephone and industrial companies. It should be understood that by no means all of the companies of a given class are listed, and that the statements published relate chiefly to the finances and officers of the companies.

DIRECTORY OF DIRECTORS IN THE CITY OF NEW YORK.—The Audit Co., of New York, 43 Cedar St. Cloth, 5½ × 7¾ ins., pp. 1224.

This is the sixth annual edition of this useful compilation, corrected to March 1, 1904. The directory is now double the size of the edition of 1898, and this copy contains 100 more pages than that of last year. It contains an alphabetical list of names of directors and trustees, with the companies in which the party is an officer, together with the New York addresses. An appendix contains selected lists of corporations in banking, insurance, transportation, manufacturing and other lines of business, alphabetically arranged, accompanied in each case with the names of the principal officers and all directors and trustees. The publishers maintain at their office a Directory Department containing lists of all officers and directors doing business in New York. These lists may be consulted at any time by subscribers to the Directory of Directors.

The Septic Tank and the Treatment of Septic Sewage.

THE TREATMENT OF SEPTIC SEWAGE.—By George W. Rafter, M. Am. Soc. C. E. No. 118, Van Nostrand Science Series. New York: D. Van Nostrand Co. Boards; 4 × 6 ins.; pp. 137; 50 cts.

More information is given in this little book than would be expected from its title. In fact, the latter might properly have been "The Septic Tank and the Treatment of Septic Sewage." As the author states, and as the governing conditions necessitate, the book is largely a compilation, but the compilation has been made with discrimination, the facts presented are interpreted in the light of American conditions, and many practical hints are given.

The book opens with a historical summary of sewage treatment, with particular reference to the recent so-called bacterial processes. Definitions, analyses of untreated sewage, brief descriptions of some of the early septic tanks and bacteria beds and reviews of experimental work at various places follow. Bacterial life in sewage and sewage works effluents, with particular reference to pathogenic or disease germs are next discussed. In conclusion, there are some useful hints on designing septic tanks, contact and percolating beds.

On page 48 the small early installation of septic tanks and contact beds at Exeter is described properly enough, but there is no reference to the much larger plant built subsequently. On page 52 it is stated that "broken stone and coke are considered to be the best" materials for contact filters, but no hint is given as to who holds that opinion. In England broken stone is rarely used for contact beds, and probably more such beds are composed of cinders or clinkers than of coke. Nevertheless, many prefer coke to any other material, and it is difficult for an American to understand why stone does not take precedence of both coke and clinkers, except in sections where broken stone is so expensive as to make the authorities forget its durability when contemplating its first cost.

On page 56 it is stated that The English Local Government Board insists that a contact bed should be used but once daily.

Such a rule may have been laid down when contact beds first came before the board for approval, but it is very doubtful whether it is now enforced. Two contacts in 24 hours are common, and three are sometimes reported.

In several places the author suggests that where a town water supply is involved, two contact beds may be supplemented by a third and finer bed. It should be made clearer that the third filter should probably be operated intermittently and at a relatively low rate if security against disease germs is desirable. Even then, it is questionable whether the sewage effluent should not be diverted to some other outlet or the water-supply itself purified.

On page 128 it is asserted that sewage may be purified by "contact beds, alone." Taken in connection with a careful reading of the whole book, this statement might do no harm, but it requires qualification so as to make clear what degree of purity can be attained, at what rate per acre, and with what difficulty through clogging the beds and with what loss of water capacity. The consensus of opinion in England, particularly as illustrated by municipal sewage works, is that contact beds alone are impracticable.

Two statements regarding percolating filters seem to require modification. On pp. 130-1 it is stated that the material composing such filters should average ¼ to ¾ ins. in diameter, which is probably too small. On p. 131 the author says:

In order that the spraying apparatus of percolating filters may work satisfactorily, all the matter in suspension in the sewage should be removed before applying it to such filters.

It would be more correct to say "all coarser matter in suspension," for without ample sedimentation, even where septic tank effluents are applied to percolating filters, large quantities of

suspended matter pass such filters. Obviously the less suspended matter the less cleaning the sprinklers will require to prevent clogging.

It will be seen that none of the points just raised are serious faults, and even if they were the book would still be a valuable addition to the literature of sewage disposal.

Concerning the Storage Battery.

THE THEORY OF THE LEAD ACCUMULATOR (STORAGE BATTERY).—By Dr. Friedrich Dolezalek. Translated from the German with the sanction of the author. By Carl L. von Ende, Ph.D. (Goettingen), Instructor in Chemistry, State University of Iowa. First edition. New York. John Wiley & Sons. Cloth; 5 x 7¼ ins.; pp. 241; illustrated. $2.50.

Within the last decade much progress has been made in the development of the lead-accumulator industry, and there has been a corresponding increase in the literature upon this subject. Dr. Dolezalek, in his preface, refers the interested reader to the small but clearly written work of Prof. Elbs on the setting up and handling of small batteries—"Die Accumulatoren;" and for a more technical treatment of the subject to "Die Accumulatoren für Stationare Elektrische Beleuchtungsanlagen—of Prof. Heim. In the latter work the author discusses the more important accumulator types, gives a detailed account of the systems of arrangement and the apparatus necessary for operation, and estimates the cost of installation. For the special expert, Dr. Dolezalek recommends the comprehensive works of Schoop —"Handbuch der Elektrischen Accumulatoren," and Hoppe's—"Die Accumulatoren für Electrizitat; the first published in Stuttgart, in 1898, and the other in Berlin, in the same year. Schoop gives a detailed description of nearly every known storage-battery system and enters into the minute detail of the methods of manufacture. Prof. Hoppe, on the other hand, records all the scientific investigation of the lead accumulator and the galvanic element.

In the present work, Dr. Dolezalek considers the reactions in the lead accumulator solely from the standpoint of the newest theories in physical chemistry; theories not recognized in the works quoted. Contrary to the opinions of some who assert that theories have been fruitless so far as the lead accumulator is concerned, the author here contends that the newer theories have a more exact application in the case of the lead accumulator than in probably any other instance.

Following the explanatory theoretical portion of the book, matters of more specific interest are treated in several chapters under the following heads:—Variation of electromotive force; variation of the electrode potential; temperature coefficient; influence of external pressure; charging and discharging; reversibility; changes in the open cell; internal resistance; capacity; efficiency; and methods of measurement.

The Series Converter.

DER KASKADENUMFORMER.—Seine Theorie, Berechnung, Konstruktion und Arbeitsweise. By E. Arnold and J. L. La Cour. Stuttgart: Ferdinand Enke. Paper; 6½ x 10 ins.; pp. 174; 38 illustrations in the text.

A single type of machine, a recent German invention, is exhaustively discussed in this book. The machine may be called a Series Converter. Bragstad and La Cour (one of the authors) patented it in Germany in 1902. The machine is designed to be an improvement on the usual means of changing alternating to direct current: motor-generators driven by either induction or synchronous motor, and rotary converters. The Series Converter is a sort of cross between the rotary converter and the induction-motor-generator set. It comprises an asynchronous (induction) motor and a direct-current generator, coupled together firmly, preferably by mounting on the same shaft. The rotor of the induction motor is cross-connected with the armature windings of the direct-current side, but in reverse order, so that the rotating field due to the rotor current flowing in the armature is stationary with respect to the external field of the direct-current side. The advantages secured by this arrangement are fully explained in the book. One of them is that, as against the ordinary rotary converter, no preliminary step-down transformers are required. As compared with ordinary motor-generator sets, the motor side does only half as much work, or less, so that economy of material is secured. The machine is self-starting, and has all desired qualities in the way of regulation, etc.

The discussion of this machine in the present work comprises a full analysis of its electrical actions, the explanation of method of calculation and design, an illustrative design worked out and a discussion of its characteristic curves.

It closes with the presentation of results of tests made at the Karlsruhe Technical College and at the works of Lahmeyer & Co., in Frankfurt-on-Main. The statement is added that Bruce Peebles & Co., of Edinburgh, are building a number of 500 and 250 KW. machines.

The book is written in a style as disinterested as that of any first-class treatise on electrical machinery, but it is none the less unique in that it is an ex parte discussion of a patented machine, put forward in the form of a regular text-book.

ELECTRICAL ENGINEERING EXPERIMENTS AND TESTS ON DIRECT-CURRENT MACHINERY.—By George F. Sever, Adjunct-Professor of Electrical Engineering, Columbia University. New York: D. Van Nostrand Co. Paper; 5½ x 8½ ins.; pp. 64; 35 illustrations in the text. $1.

The method and style of this little manual is clear and direct throughout, which is of especial importance in the instruction that must form the basis of all the higher knowledge of electrical work. The number of the experiments presented is not great, about a dozen, but they serve to introduce all important points in the working of ordinary direct-current machinery. The experiments include the measurement of resistances by various methods, the determination of magnetization curves from the operation of a dynamo, the study of characteristic curves of dynamos and motors, brake tests of motors, "stray power" measurements of efficiency, the operation of dynamos in parallel, and the operation of arc-light dynamos and of arc lamps.

Directions for arranging apparatus for the experiments, hints as to necessary precaution, together with diagrams of connections, are given for each experiment. A convenient form of schedule of observations is given in most cases, and plotted curves of results are called for. It will be seen from this that the instructions are quite detailed, a thing which has repeatedly been condemned as undesirable, because tending to make the student follow directions rather than think. Yet this manual is quite suggestive in effect, the purpose apparently being to direct the attention of the student to all peculiarities of machines or difficulties that may arise in their operation. The book may prove serviceable (beyond its use as a laboratory aid) as a guide in conducting acceptance tests of ordinary direct-current machines.

O'GORMAN'S MOTOR POCKET-BOOK.—By Mervyn O'Gorman, M. I. E. E., Assoc. M. I. M. E. A Judge in the Automobile Club's Irish events, 1903, and in the Auto-cycle Club's 1,000-mile reliability trials; member of the races committee and driving certificate committee of the Automobile Club, and of the Auto-cycle and Motor-cycle Executive Committees. New York: E. P. Dutton & Co. Cloth; 4½ x 6⅝ ins.; pp. 387, 144 illustrations.

The author is undoubtedly an expert in the running and detail management of automobiles, and he here proceeds to impart this information to others interested. This information is arranged in alphabetical order and embraces a wide range of material, from the most suitable dress for the driver to the handling, adjustment and repair of the more intricate parts of the machine. The text includes much tabular matter useful to the automobilist; and interspersed with detail advice, we have the bibliography of the motor-car, with prices and the addresses of the publishers; tables of foreign money; the English laws regulating the use and sale of petroleum; a French-German-English vocabulary of parts of a motor-car; the racing rules of French and English automobile clubs, etc. The motor-bicycle is largely treated in this pocket-book. While the basis of the work is English practice, this is so similar to that of the United States that the book is very useful here. It is well illustrated.

ANNUAL REPORT UPON THE SURVEY OF THE NORTHERN AND NORTHWESTERN LAKES, being Appendix FFF of the annual report of the Chief of Engineers for 1903. Washington: Government Printing Office. Paper; 6 x 9 ins.; pp. 660-665 and pp. 2671-2884; maps and illustrations.

This annual report of Maj. Walter L. Fisk, Corps of Engineers, U. S. A., details the work of the year in his district. A very creditable piece of precise leveling was done by Junior Engineer A. H. Horton, in connecting the Greenbush Bench at Albany, N. Y., with the U. S. Lake Survey Bench at Oswego. By the line followed the distance was 206.1 miles, and fully three-fourths of this line fell within the error limit of 2mm. $\sqrt{}$ distance in kilometers; and only a very small fraction even approximates 3mm. $\sqrt{}$ distance in kilometers; the distance being measured between bench marks. The progress made by these levels averaged 1½ miles of completed line per day, making no allowances for Sundays, holidays or bad weather. The report of Mr. Horton gives the full detail of this leveling survey, which definitely fixes the elevation of all the Great Lakes above tide water. This report of Maj. Fisk covers an accurate series of discharge measurements in the Detroit, St. Clair and St. Mary's Rivers, in continuation of the exhaustive investigation of lake levels commenced in 1898.

HISTORY OF THE HOUSE OF P. & F. CORBIN.—Including Portraits of Men Notably Identified with the Growth of the House. Issued in commemoration of the Fiftieth Anniversary of the founding of the house on the fourteenth day of February in the year 1854. Cloth; 7¼ x 9½ ins.; pp. 105; illustrated.

This story of the development of a pioneer establishment for the manufacture of American hardware is sufficiently interesting in itself to warrant decided notice. But this particular history is to be especially commended as a piece of bookmaking, for its exquisite typography, ornamentation, illustration and binding. The story itself is simply told, but it well points out the reward awaiting a similar exhibition of energy, patient devotion to business, intelligent study of the public demand and the ability to select the right men for the right place. This house, in fact, created its business, step by step, and invented the appliances for making a better and cheaper article than was then imported, and finally drove out foreign competition. It is remarkable in the history of industrial enterprises of a similar age that the man who founded this business fifty years ago is still its active head.

ST. MARY'S FALLS CANAL, MICH.—Statistical Report of Lake Commerce Passing Through Canals at Sault Ste. Marie, Michigan and Ontario, during season of 1903. Prepared under the direction of Major W. H. Bixby and Major W. L. Fish, Corps of Engineers, U. S. A. No imprint. Sent out by Joseph Ripley, General Superintendent, St. Mary's Canals, Mich. Paper; 6 x 9 ins.; pp. 22; illustrated.

These statistics relate to both the American and the Canadian Canals at this place, separately tabulated; the American canal traffic representing 84% of the total freight and 42% of the passenger traffic for the season of 1903. The total freight traffic for the year was 34,674,437 net tons of 2,000 lbs., or a decrease of 4% from the total of the record year of 1902. In all, 18,596 vessels passed through the canals, or 18% ess than in 1902. The season of navigation extended over 8 months and 14 days. The total value of freight carried amounted to $349,405,014—as contrasted with $128,178,208 in 1891, and $30,000,000 in 1881. The relative percentages of monetary values of freight are as follows: Coal, 7.12; cereals, 29.71; iron, 26.80; copper, 7.23; lumber, 5.17, and all other products, 23.77%. The freight charges collected in 1903 amounted to $26,727,735.17 for both canals. The American vessels using the canals numbered 799; 97 of these vessels having a length of from 400 to 500 ft., and a beam of 45 to 53 ft.; 126 other vessels were from 300 to 400 ft. long, with beams of 38 to 50 ft.

The following general summary of the American and Canadian canals together contains much condensed information:

Total ton-miles	28,974,660,408
Total freight carried—tons	34,674,437
Total valuation on freight carried	$349,405,014
Average distance freight was carried—miles	835.6
Cost per mile per ton—mills	.92
Average cost per ton for transportation	$0.77
Total of registered vessels using canal	805
Total of unregistered vessels carrying freight	361
Time American canal was operated—days	249
Time Canadian canal was operated—days	256
Total valuation of registered vessels	$74,637,300
Total passengers carried	55,175
American vessels carried, of freight—per cent.	94
American vessels carried, of passengers—per cent.	35

The Philippines.

CENSUS OF THE PHILIPPINE ISLANDS.—Director, Gen. T. P. Sanger, U. S. A.; Assistant Directors, Henry Gannett and Victor H. Olmstead. Washington, D. C.: Department of Commerce and Labor, Bureau of the Census. Paper; 6 × 9 ins.
Bulletin No. 1: Population of the Philippines; pp. 100.
Bulletin No. 2: The Climate of the Philippines. By Rev. Jose Algue, S. J., Director of the Philippine Weather Bureau; pp. 103; charts.
Bulletin No. 3: Volcanoes and Seismic Centers of the Philippine Archipelago. By Rev. M. Saderra Maso, S. J., Asst. Director Philippine Weather Bureau; pp. 80; illustrated.

This census was the first serious attempt to count the peoples of our new possessions in the East. Within the area of the 832,968 sq. miles of land and water covering the many islands of the Philippines dwells a population of 7,635,426 souls. Of this number 6,987,686 are classed as civilized, or partly so; while 647,740 are wild and uncivilized. Of the Negritos, or the probable aborigines of the Philippines, 23,000 still remain. These people are very short, the males averaging 4 ft. 10 ins. in height, while the women are shorter. Their color is black, hair woolly and bushy, and their toes are remarkably prehensile, so that they can use them almost as well as their fingers. They wear little or no clothing; have no fixed habitations, and are skilful in the use of the bow, in throwing stones, and in making a fire by rubbing together two pieces of dry bamboo. They are as nearly akin to our conception of primitive man as any people yet discovered. They preceded the Malays in the occupation of this group of islands, and, as people of the same type are found in the Malay Peninsula, the Andaman Islands and the Bay of Bengal, it is believed that they once occupied the entire Malay Archipelago, and were driven out by the present Malays.

Excepting the Negritos, all the wild tribes still found in the islands are of Malay extraction, and among these the Mohammedan Moros are the most prominent, and were formerly the most aggressive, making attacks upon all the settlements in the southern islands, going even to Manila.

Considering land alone, the area of the Philippine Islands is estimated to be 115,026 sq. miles, or 73,616,640 acres. Of this area about 12,000,000 acres only are in private possession. Of the 61,000,000 acres of public lands, 40,000,000 acres or more are forest land, leaving 21,000,000 acres available for agriculture. Much of the forest land is of great richness, and, if cleared, would be capable of a high degree of cultivation. The most valuable products now are—the abaca, or Manila hemp, fine sugar, rice, coffee, cacao and tobacco. Under existing laws, a homestead of 39.54 acres can be acquired by any citizen of the islands, while a corporation may acquire 2,530 acres. But the grant or sale of this land is conditional upon actual and continual occupation, improvement and cultivation for a period of not less than five years.

A forthcoming Census Bulletin will deal with the Philippine industries, and particularly with agriculture. At the present time the making of cigars represents the only manufacture on a large scale found in the islands, though considerable quantities of sugar and hemp have been exported in past years. The statistics of population are given in detail by islands, provinces, municipalities and "barrios."

In Bulletin No. 2 tables show that the maximum temperature is 30° C., or 86° F., in the months of April, May and June. Only north of the parallel 18° N. Lat. is there any pronounced difference between the extreme seasons, or Winter and Summer; and as the bulk of the archipelago lies south of this parallel, this difference almost disappears. In Manila the average temperature for the period 1883-1902 is about 80° F., the lowest temperature in this period being 78° F. The mean annual rainfall varies widely in different parts of the group, ranging from under 40 to over 120 inches. The reports treat fully of the movement of the atmosphere, typhoons, etc.

Bulletin No. 3 shows that the Philippines lie in the volcanic belt stretching from Northeastern Asia, through the Japanese Islands, nearly to Australia. Several volcanoes in the group have been in active operation in recent years, and there are scores which are extinct or dormant. For many years Manila has had one of the best-equipped seismic observatories in the world, and most careful records have been kept by Father Maso and his predecessors. The report goes into the detail of these records, and gives accounts of eruptions and earthquakes within the historic period on the islands.

THE STREET PAVING PROBLEM OF CHICAGO.—A Report to the Street Paving Committee of the Commercial Club. By John W. Alvord, Consulting Engineer. And an Opinion of John S. Miller, Esq., on Maintenance and Repair of Chicago Streets. Chicago: R. R. Donelley & Sons Co.; 7¾ × 10½ ins.; pp. 33; illustrated.

This report to the Commercial Club was ordered by the Club for the purpose of acquainting the public with street conditions, and for inciting intelligent interest in the practical solution of the problem. Mr. Alvord takes up the question of paving from a general and historical viewpoint, and then discusses in considerable details the local conditions in Chicago. One of the worst conditions to contend with there is the existence of 708 miles of round cedar block pavement, with the spaces filled with gravel and coal tar. About 80% of this wood pavement is worn out, and should be replaced. Of other pavement Chicago possesses 421 miles of macadam, 132 miles of asphalt, 68 miles of brick, 38 miles of stone block, and 4 miles of various materials, making a total of 1,371 miles. The cedar-block pavement of Chicago, says Mr. Alvord, represents an investment of about $15,500,000. About 150 miles of streets in the city are still unpaved, though they are provided with water mains and sewers. Mr. Alvord says that in 1902 no less than 20,200 permits were granted to public service corporations for tearing up the pavements; about 14,000 of these were for gas connections. This means a total of 200,000 sq. yds. of pavement, equivalent to 10 miles of streets, 36 ft. wide, torn up in one year. Mr. Alvord claims that the money thus annually expended would build six miles of pipe subway, and in ten years complete a subway system covering many of the heavily travelled streets of the city. The old-fashioned flat rail is still in use on many of the street railways, and is responsible for deep parallel ruts; this rail, however, is being gradually replaced by the grooved rail. The author believes that Chicago is now in a position where it must expend about $16,000,000 to repair the mistakes of the past in paving, and he thinks it would be wise for the city to now obtain the best expert advice in the adoption of new plans and the expenditure of this money. Mr. Alvord himself limits his suggestions to more grass space, lower curb-lines, no street paving out of the business district much over 18 ft. wide, the planting of trees, etc. Among the illustrations are a series of graphic representations of the percentages of various classes of pavements in a number of large cities of the United States.

STABILITY OF INTERNATIONAL EXCHANGE.—Report on the introduction of the gold-exchange standard into China and other silver-using countries. Submitted to the Secretary of State, Oct. 1, 1903, by the Commission on International Exchange, House of Representatives, Document No. 144, 58th Congress, 2d Session. Washington, D. C., Government Printing Office, 1903. Cloth; 6 × 9 ins.; pp. 518.

The members of this Commission, Hugh H. Hanna, Charles A. Conant and Jeremiah W. Jenks, have here compiled a vast amount of useful information upon this subject. The report covers the work done by the foreign commissioners; and much space is devoted to discussing the monetary policy of Mexico and China, and the currency system of the Straits Settlements, British India, French Indo-China, and the Philippine Islands. Attention is also paid to the gold-exchange system in other countries and the subject of stable exchange is generally discussed. The conclusion arrived at is: That great benefits to the trade of the United States and other exporting and manufacturing nations must result from the adoption of a stable exchange in China, in place of the fluctuating silver standard upon which her transactions are now based. The experience of Russia and Japan is that the introduction of a gold standard increases foreign trade and the investment of foreign capital.

CONTRACT ACCOUNTS.—Everett Audit Co., Chicago and New York. 6 × 9 ins.; pp. 55.

This pamphlet explains the system of accounting devised by the Everett Audit Co. for MacArthur Bros. Co., Contractors, Chicago, Ill. It is intended that every engineer, foreman, bookkeeper, and every man having to do with ordering supplies, machines, tools, etc., shall be furnished with a copy of this pamphlet for his guidance. The purpose of this system of accounts is to furnish a concise monthly report showing accurately the progress of the work, the actual profit or loss, subdivided according to the several classifications of the work performed; also to secure a uniform classification of expense items or account at the general office.

Instructions in detail are given as to entries to be made in Cash Receipt, Cash Payment, Petty Cash, Journal, Ledger and other books. Detailed instructions are given to time keepers, as to the records that they must keep; and, in a word, every member of the executive, managerial and recording staff of employees is told concisely how he must keep his records.

PUBLICATIONS OF THE EARTHQUAKE INVESTIGATING COMMITTEE, IN FOREIGN LANGUAGES. No. 15. Tokio, 1904. Paper; 7 × 10¼ ins.; pp. 72; half-tones and folding diagrams.

This entire number is devoted to the application of the seismograph to measuring the vibration of railway carriages, an application first made by Prof. John Milne. Mr. F. Omori, in contributing the present article, says that the problem of an accurate absolute measurement of this vibration is yet far from being solved; though fairly good results can be obtained by using due precaution against sources of error and carefully analyzing results. The object of the experiment made by him in 1902-03, was to determine (1) The range of motion and period of the vibrations; (2) to note the difference in motion in running on the ground and in passing over bridges; (3) to note effect on the rail joints; (4) the relation between vibrations and train-velocity; (5) effect of curves and frogs; and (6) the influence of the vibrations on the overturning of cars. He gives the full tabular details of his experiments in each of the above cases; but makes no definite conclusions.

LABOR LAWS OF THE UNITED STATES. Prepared under the direction of Carroll D. Wright, Commissioner of Labor, for the Committee on Interstate and Foreign Commerce of the House of Representatives, to accompany report submitted by Hon. John J. O'Neill, of that Committee, July 20, 1892. Second edition, revised to include latest published laws. Washington, D. C.: Government Printing Office. Cloth; 6 × 9 ins.; pp. 1,383.

This compilation was originally published in 1892; and the present volume is issued in compliance with a resolution of Congress of March 5, 1896, directing the Commissioner of Labor to revise the previous report so as to include labor legislation enacted subsequent to 1891, and to annotate the report with reference to decisions of courts under the laws given. The first chapter of the report covers legal holidays created by State laws; a digest of the apprentice laws; a statement of the relations of employer and employee; and a list of employments or occupations, the followers of which are declared to be or not to be fellow-servants by the decisions of courts arising under the common law. Chapter II contains the labor laws passed by Congress and the various States and Territories prior to 1896; the third and last chapter treats of the decisions of courts upon the various laws deemed best to annotate.

UNITED STATES CENSUS BULLETINS.—Department of Commerce and Labor, Bureau of the Census, S. N. D. North, Director. Paper; 9 × 12 ins.; tables.
No. 7: Estimates of Population of the Larger Cities of the United States in 1901, 1902, 1903. Pp. 21.
No. 9: Mines and Quarries. Pp. 59.
No. 11: Municipal Electric Fire Alarm and Police Patrol Systems. Pp. 33.

The estimates of population in Bulletin No. 7 include 438 places which had a population of 10,000 or more in 1900. The general basis of the estimates is to assume a yearly increase based on the actual average yearly increasing between the censuses of 1890 and 1900, with allowances for annexed territory, where known to exist. It may be said that this method of estimate has the approval of an official committee, and that the reasons for its adoption are set forth at length in a

bulletin (No. 135) of the Twelfth Census of the United States, prepared by Prof. Walter F. Willcox.

The bulletin on "Mines and Quarries" gives statistics for the year 1902, compiled in conjunction with the U. S. Geological Survey.

Bulletin 11, on "Municipal Electric Fire Alarm and Police Patrol Systems," also covers the year 1902. It is the first census of the kind attempted in this country. The text was written by Mr. T. Commerford Martin, and includes some interesting historical notes. Earlier bulletins in this series dealt with street railways (No. 3) and with electric light and power plants (No. 5).

A Catalogue of Some Conveying and Handling Devices.

TECHNISCHE HULESMITTEL ZUR BEFORDERUNG UND LAGERUNG VON SAMMELKORPERN.—By M. Buhle, Professor in the Royal Technical College at Dresden. Berlin: Julius Springer. Cloth; 9½ × 13 ins.; pp. 202; 10 plates and 551 illustrations in the text. $6.

We are pretty well used to the belief that German technical books of the better class are thorough-going, detailed treatises of a high grade of excellence within their proper limits. Whether this belief is ill-founded, or whether, if correct, it receives confirmation from a total exception, the fact is that this latest work of Mr. Buhle is in no way fitted by the above characterization. It has an ambitious title, and a preface which awakens interested expectation; both are belied by the contents. It may be that some palliation of this condition is offered by the fact that the book is only part of a more complete work, being Part II of a work whose general title is the same as that given to this book. But such apology can hardly be accepted, since not only is the content of the book very heterogeneous, but it is not sufficiently coherent to permit judgment as to whether it covers comprehensively any definite plan or outline. Moreover, no such plan is indicated in either preface or text. The book actually is a bound collection of reprints from various German technical periodicals, from which the type and illustrations appear to have been lifted bodily. Dealing with widely-distinct subjects, on various occasions, and often in purely commercial, "trady" manner, these instalments do not produce a happy effect in their inedited juxtaposition. But the author takes repeated occasion, in preface and in text, to specially defend and even laud this method of publication. He seems to claim for it, what is not altogether convincingly evident, that the material is all a definite part of the definite plan of a comprehensive work, and that its serial publication in various journals had the object only of making the material more rapidly available to the public. The merits and demerits of this latter plan are not now in question; the fact alone is pertinent that the results in the present case are not happy.

The contents of the book are, briefly, the following: Section I. describes various types of conveyor made by one German maker. They include vibratory conveyors, reciprocating scraper conveyors, spiral conveyors, chain-belt scraper conveyors, belt conveyors, and elevators. The treatment is cursory description. Section II., entitled "Compressed-Air Locomotives," describes several of these, but also an electric locomotive, a steam engine, and a power-house. This section seems quite out of harmony with the general scope of the book. Section III. is a short description of some belt-conveyors, some bridge conveyors of the coal-handling type, and some cableways. Section IV. describes the coal-handling plant of a German gas works. Section V. illustrates several railway freight cars and some miscellaneous railway material exhibited at Düsseldorf in 1902. The next three sections are short "write-ups" of Robins belt-conveyors, the Bousse link-belt conveyor, and a few pneumatic hoists of one German maker. Section IX., which is an article on the Municipal Exhibition at Dresden, 1903, contains as varied material as can be put into 14 pages. Section X. describes, in catalogue style, a line of automatic stoking and forced-draft appliances, and a line of grain and malt machinery, made by one firm. The section contains among other things pictures of malt-houses, views of recording thermometers and thermostats. Section XI. is a similar "trady" compendium of one maker's automatic weighing machines. Finally, the last and longest section, of 55 pages, describes superficially a number of grain-elevator installations, and contains, among other illustrations, half a dozen large half-tone plates of views of grain elevators.

ELEMENTS OF WATER BACTERIOLOGY.—With Special Reference to Sanitary Water Analysis. By Samuel Cate Prescott, Assistant Professor of Industrial Biology, and Charles-Edward Amory Winslow, Instructor in Sanitary Bacteriology, in the Massachusetts Institute of Technology. New York: John Wiley & Sons, London: Chapman & Hall. Cloth; 6 × 8 ins.; pp. 162; tables, and one figure in the text. $1.25.

Although it is distinctly stated in the preface that this handbook assumes a prior knowledge of general bacteriology, it cannot fail to be of use to other people responsible for the character of water supplies. Both the technic and the interpretation of bacterial analyses are treated in clear and readable language. One of the most commendable features of the book is its recognition of limitations of the art, while at the same time setting forth its legitimate claims. The last chapter, entitled "The Significance and Applicability of the Bacteriological Examination," is particularly valuable. Its closing sentence reads as follows:

> The evidence furnished by inspection and by chemical analysis should be sought for and welcomed whenever it can be obtained, yet we are of the opinion that, on account of their direction, their delicacy, and their certainty, the bacteriological methods should least of all be omitted, and, if necessary, they alone may furnish conclusive testimony as to the safety of a potable water.

FORMULAIRE DES CENTRAUX.—Résumé par ordre alphabetique des cours et projects de l'Ecole Centrale. Augmente de tables usuelles et d'un abrege de legislation. Par J. B., Ingenieur des Arts et Manufactures. Deuxieme edition revue, corrigee et completee. Paris: Vve. Ch. Dunod, Editeur, 49 Quai des Grands-Augustins. 1904. Flexible leather; 4 × 6 ins.; pp. 314; illustrated. 6 francs or $1.80.

This is a novel presentation, in alphabetical or dictionary form, of the formulas and elements necessary for the solution of problems relating to mechanics, construction, electricity, hydraulics, etc. The aim of the author has been to give this information without any superfluous detail, and to thus condense into a pocket-book form a mass of useful material. It is based upon the concise and ingenious methods taught by the professors of the Ecole Centrale. By the use of small but clear type, this little volume practically contains the useful contents of the larger Aides-Memoire, which are only available for office use. Small as it is, in the present work the pages are only printed on one side, so that blank pages are available for further additions by the owner or user. The contents cover three main divisions—the formulas, useful tables, and an abridgment of commercial and industrial law.

WATER SUPPLY AND IRRIGATION PAPERS, U. S. GEOLOGICAL SURVEY.—Charles D. Walcott, Director, Washington, D. C.; Pub. Doc. Paper; 6 × 9 ins.

No. 91: The Natural Features and Economic Development of the Sandusky, Maumee, Muskingum, and Miami Drainage Areas in Ohio. By Benjamin H. Flynn and Margaret S. Flynn. Pp. 130; tables and 11 figures in the text.

No. 92: The Passaic Flood of 1903. By Marshall Ora Leighton. Pp. 48; 7 plates and 2 figures in the text.

Prior to his death, the late Mr. Flynn had been engaged for some years in a study of the drainage areas of Ohio, carrying on the work both as Engineer of the Ohio State Board of Health and as field assistant in charge of stream measurements for the U. S. Geological Survey. The death of Mr. Flynn has brought to public knowledge what was well known to some of his friends, namely that for a number of years Mrs. Flynn had coöperated in these studies. She has since completed the paper now under notice.

The paper opens with a general description of the drainage areas already named, after which the flow of the several streams, the dams and water powers on each and the public water supplies which they afford, are presented. The information relating to water-works includes descriptions of the several plants and figures relating to the use of meters and to water consumption.

Mr. Leighton's paper on "The Passaic Flood of 1903" is virtually a continuation of a similar one (No. 88) on the Passaic flood of 1902, written jointly by the same author and Mr. Geo. B. Hollister. Besides giving the precipitation and stream flows for the later flood and describing the flood effects in various portions of the drainage area, Mr. Leighton devotes 18 pp. to "Preventive Measures." He includes extracts from a report of the engineering committee of the Northern New Jersey Flood Commission, of which commission he was a member. Mr. Leighton's final recommendations are for flood storage reservoirs in the Passaic drainage area.

IRRIGATION IN THE DUTCH EAST INDIES.—By J. W. Post, Engineer of the Dutch East Indian Railways. Institut Colonial International, 36 Rue Veydt, Brussels, Belgium. Paper; 6 × 9 ins.; pp. 68.

This is a reprint of a paper presented at the meeting of the International Colonial Institute at Wiesbaden (Germany) in May, 1904. The most extensive work has been done in Java and Bali, the latter being mainly by the natives. There is also some irrigation in Sumatra. The principal purpose of irrigation in Java is the development of rice cultivation. The works include drains to remove the surplus water after irrigation. About 25 pages are devoted to the official "Instructions to the Chief Engineer of Irrigation Works."

Accompanying this pamphlet is another of seven pages containing Mr. Post's address delivered at the meeting, which reviews the question of irrigation in tropical and sub-tropical countries. In regard to work of this kind in the United States, there is simply a word of mention of irrigation in the arid region and its application to fruit culture in California.

THE VOSMAER SYSTEM OF PRODUCING OZONE FOR THE PURIFICATION OF WATER AND OTHER PURPOSES.—Report by J. J. de Kinder. Philadelphia: The United Water Improvement Co., Drexel Building. Paper; 6 × 9 ins.; pp. 87; tables and illustrations.

Although this is a thinly disguised trade publication, it deserves more than casual mention. It brings together a variety of scattered information on the production of ozone and the results obtained by treating water with ozone. Studied with the caution necessary in the case of most trade publications, the pamphlet may prove valuable to many. Possible confusion as to what is original and what is quoted matter would have been saved by using a smaller type for the latter. Mr. de Kinder visited Europe to secure material for his report, which deals almost wholly with European theory and practice.

THE POLYTECHNIC ENGINEER.—The Annual Organ of the Engineering Society of the Polytechnic Institute of Brooklyn, 1903-4. Oskytel H. Clarke, Editor-in-Chief. Brooklyn: As above. Cloth; 7 × 10 ins., pp. 156; illustrated.

Most of the papers in this annual deal with electrical subjects. There is one on a diversion weir or dam near Lamar, Colo., and another on irrigation in Colorado.

ASSOCIATION OF CIVIL ENGINEERS OF CORNELL UNIVERSITY.—Vol. XII., 1903-4. Containing Addresses by Non-Resident Lecturers, Miscellaneous Papers and a List of Members of the Association. T. L. Jacobs, Editor. Ithaca, N. Y.: C. L. Crandall, Corresponding Secretary. Paper; 6 × 9 ins.; pp. 87; illustrated.

The subjects treated in the papers and lectures here printed include concrete, bridges, railway work, surveying and water purification.

THE MICHIGAN ENGINEER.—Containing the Proceedings of the Michigan Engineering Society for 1904. Climax, Mich.: F. Hodgman, Secretary. Paper; 6 × 8 ins.; pp. 299; illustrated. $1.

Some 25 papers on water supply, the treatment of sewage, surveying, heating, coal tests, gas engines, and other subjects make up the bulk of this volume.

WORLD'S FAIR SOUVENIR OF THE ENGINEER'S CLUB OF ST. LOUIS.—Paper; 6 × 9 ins.; pp. 147; tables and illustrations. St. Louis, Mo.: The Club.

The officials and members of the Engineers' Club of St. Louis, who co-operated in the production of this volume, have performed a creditable and useful work. Some 24 pages are devoted to the Exposition, 44 to the engineering features of St. Louis and vicinity, 50 to local engineering data, which is largely statistical, and the balance to the club itself.

British Plumbing Practice.

THE DRAINAGE OF TOWN AND COUNTRY HOUSES. A practical account of modern sanitary arrangements and fittings. By G. A. T. Middleton, Assoc. Royal Institute British Architects, etc. London, 1903: B. T. Batsford, 94 High Holborn. Cloth; 5½ x 7⅝ ins.; pp. 150; illustrated.

Now that the principles underlying the drainage of houses are better understood, and the appliances available for such purposes are better designed and more serviceable, books of this type are becoming more and more useful both to sanitary engineers and to householders. At the present time—with intelligent supervision and at some extra cost, an isolated country house can be as well drained as the house in the city, and this to the great advantage of its occupants in matters of health.

The author enters into the detail of house drainage—from a British point of view; lays especial stress upon the importance of disconnection and inspection chambers, at bends and meeting points outside of the house; and the chapter on pipes and joints is a very good one. Cast iron is preferred to stoneware pipes, largely because of the difficulty of making and keeping the numerous joints in the latter watertight. In this chapter the author describes and illustrates a number of English pipe sections, joints, back-pressure stoppers, expansion sockets, cleaning joints, etc. The chapter on water closets and latrines is very full, and this is followed by chapters on slop and hospital sinks, on urinals and on sinks and baths; each chapter is well illustrated. Rain-water disposal and stable drainage are briefly treated. Flushing drains for periodical flushing and complete cleansing of both the house and stable drains are described. The use of these appliances is only necessary where the fall is insufficient, or there is not enough of flushing from a bath or a similar fitting at the head of a drain. Drain-testing forms an important chapter; the smoke-test, applied by a machine made by the Grahtryx Ventilating Co., of London, is especially commended as preferable to smell tests. This is nothing more than a fan which drives the smoke produced by the combustion of oily waste into a soil pipe under considerable pressure.

Sewage disposal is not discussed, except in relation to isolated houses. In a short chapter the author gives some general advice upon this latter subject, but he illustrates and concisely describes the septic-tank method of purification.

The final chapters are devoted to a model specification for house drainage, with notes on appliances and workmanship; to model by-laws relating to house drainage, as formulated by the English Local Government Board; and to the making of a drainage survey and report. The Appendix gives examples of examination papers in house drainage, as laid down by the Royal Institute of British Architects.

TRAIN RULES AND TRAIN DISPATCHING.—A practical guide for train-dispatchers, enginemen, trainmen and all who have to do with the movement of trains. By H. A. Dalby. New York: The Derry-Collard Co. Flexible leather; 4 x 6 ins.; pp. 221; illustrated. $1.50.

How the immense railway traffic of this country is handled, certainly and safely, is a puzzle to the layman, and is in itself a most interesting story, here well told. The author, commencing with the establishment of Standard Time and its meaning, takes up the time-tables, the authority for the movement of all regular trains subject to the rules of the road. He shows how this is made up and handled in connection with the divisions, districts, terminals, classes and rights of trains. The "Electric Staff System" is also explained. This is now in use in a number of places where there are short pieces of single track, or at large terminals. Train orders have considerable space given to their "forms" and use on a railway, the discussion covering "extras." The handling of Work Trains comes next, and, owing to the great diversity of practice in moving trains of this type, on different roads, the practical advice here given is valuable. In succeeding divisions of the subject the following details are treated: Change in time tables; Train Order Signals, with colored illustrations; Train Registers and Clearance Cards; another section consists of advice to operators, dispatchers, enginemen and trainmen, indicating the absolute necessity of working together in all matters pertaining to the conduct of the road; and in a similar vein, we have suggestions to young train dispatchers in the form of some practicable problems. The Standard Code of the American Railway Association is given, along with selections from the Standard Code of Train Rules for Double Track, the latter taking up such rules and train orders as differ materially from single track rules, or apply only to double tracks. At the end of the book is a useful table showing the dividing points, or the Standard Time Sections, for the United States. The concluding part is a series of illustrations showing the use and meaning of hand, flag and lamp signals and the train signals, the last in colors.

IRRIGATION WATERS AND THEIR EFFECTS.—By William P. Headden. Bulletin No. 83, The Agricultural Experiment Station of the Colorado Agricultural College. Fort Collins, Colo.: The Experiment Station. Paper; 6 x 9 ins.; pp. 16.

A more technical presentation of Professor Headden's studies along this line was published as Bulletin No. 82, on "Colorado Irrigation Waters and Their Changes." The present bulletin is intended to be popular in character and while presenting some of the conclusions previously stated it is quite independent of the earlier bulletin. The main conclusion given herein is that the sediments carried by the irrigation waters under consideration are not sufficiently valuable to agricultural land "to make their application a matter to be sought after." Bulletin No. 82 was noticed briefly in page 36 of this Supplement for Oct. 15, 1903.

AMERICAN AND EUROPEAN HIGH-SPEED TRAINS. —By George G. Tunell, Chicago. (Reprinted from the "Journal of Political Economy.") Paper; 7 x 10 ins.; pp. 45.

This paper deals with three subjects: (1) The speed of the most famous trains of the world; (2) a comparison of train service between important cities in the United States and Germany; and (3) a reply to a German discussion on high-speed trains. Mr. Tunell shows that American cities have a much better train service than German cities of approximately equal importance.

THE RAILWAY SIGNAL ASSOCIATION.—Proceedings of the Meeting held in the Year 1903. New York: The Association. 83 Fulton St. Paper; 6 x 9 ins.; pp. 92; illustrated.

This sixth volume of the Proceedings (formerly the Railway Signaling Club) contains the reports of five meetings. There are no individual papers, but several committee reports, with the discussions on these latter and on a number of topics connected with signal derign and the practical work of signaling. Some of the subjects discussed are as follows: The operation of distant signals; Automatic signals for single track; Three-position signals; Track circuits; Mechanical and time locks; Block signals for fast trains; Automatic stops; Cost of maintaining signals; Railway organization. The volume also contains the constitution and list of members.

WIE EINE MODERNE THEERDESTILLATION MIT DACHPAPPENFABRIK EINGERICHTET SEIN MUSS. —By Willy Peterson. Vienna: A. Hartleben. Paper; 6½ x 7⅛ ins.; pp. 222; 77 illustrations in the text and 1 folding plate.

The author aims to give detailed practical instructions for building and operating a coal-tar refinery. Without entering into the chemistry of coal-tar products, or even into a general discussion of the art, he sketches the arrangement and equipment of a medium-sized plant working up about 10 tons of crude coal-tar per day. The various retorts, tanks, coolers, washers, mixers, etc., are separately considered, and drawings are given to show their construction, all with specific reference to the plant taken as example. Similarly the method of working each department is outlined in some detail.

ELEVENTH ANNUAL REPORT, MASSACHUSETTS HIGHWAY COMMISSION. 6 x 9 ins.; pp. 92.

This report states that the number of miles of road finished during the year of 1903 in the State of Massachusetts was 67, making a total of about 482 miles of completed state highway. The total number of petitions, up to date, cover altogether 1,663 miles of road, showing conclusively the popularity of the law under which state road work is done, not to mention the satisfaction with the methods of construction used by the Highway Commission of Massachusetts.

The report states that nothing has developed that would warrant a return to the use of the telford system of road building, the methods of draining and the use of gravel foundations on subsoil having thus far proved cheaper and equally satisfactory. Many of the culverts and short bridges built during the past year have been of reinforced concrete, the structures presenting a neater appearance and being fully as strong as those of masonry, though costing less. Repair work is now being done largely by contract. The total cost for repairs during the year of 1903 was $55,000, in round numbers.

An interesting table is given, showing the wear of different classes of stone per year, under different classes of traffic. The Commission has under its control seventeen steam rollers, and the total number of days' work during the year was an average of 104½ days per roller; the cost of maintenance of the rollers being $2,051. It is the opinion of the Commission that the state rollers are an excellent investment. Long tables are given of the different roads thus far built, giving their respective lengths, widths, etc. Tables are also given of contract prices, and costs of road construction; but, unfortunately, the tables do not show the respective quantities of earthwork, macadam and other items required to build each road. The engineer who is endeavoring to compare the cost of road construction in different sections will find this omission a serious defect in the report.

IMPROVEMENT OF PUBLIC HIGHWAYS.—Bulletin No. 6. Proceedings of the Fifth Annual Good Roads Convention of the Board of Supervisors of the State of New York. Department of the State Engineer and Surveyor, Albany, N. Y. Paper; 6 x 9 ins.; pp. 103; illustrated.

This bulletin is notable for the large number of excellent photographs of roads, "before and after," constructed under State aid in the State of New York. Among the most interesting of these are views of shale roads built by the State Engineer in Orange County. The speeches and the reports of committees all contain matter of interest to those who desire to study the progress of State aid in roadbuilding, the laws that have made such progress possible in New York State, and the laws proposed to effect still more rapid progress toward a system of hard roads throughout the State.

DRAINAGE OF FARM LANDS.—By C. G. Elliott, M. Am. Soc. C. E., Drainage Expert (Irrigation Investigations), Office of Experiment Stations. U. S. Department of Agriculture, Washington, D. C. Pub. doc. (Farmers' Bulletin, No. 187). Paper; 6 x 9 ins.; pp. 40; illustrated.

This is a practical pamphlet, written by an engineer of long experience in this branch of work, and, although it is written specially for the use of the farmer, it is of almost equal value to the engineer. After discussing the character of soil, and the relation of drainage to soil conditions, the subject of open drains is taken up, including the use of these as outlets for tile drains. The section of such ditches is discussed, and also the methods of construction, including scrapers, capstan plows and dredges. Attention is called to the necessity of deep ditches, shallow ditches being often entire failures as drainage outlets. The greater part of the pamphlet is devoted to tile drainage, including the depth and location of the drains. In regard to surveys and grades, Mr. Elliott remarks that "whatever may be said to the contrary, it remains a fact that in order to get the best results in a system of drainage the work should be laid out with a leveling instrument and executed in accordance with the survey made." For large tracts of level land especially the services of an engineer are indispensable. The size of tile is next considered, and tables are given showing the areas drained by drains of different diameter, length and grade. The methods and tools used in trenching and tile laying are described, but as to trenching or ditching machines, it is pointed out many of these have failed to meet the requirements, although a few seem to work satisfactorily where the ground is sufficiently firm. Then follows a presentation of the cost and profit

of tile drainage, and the value of co-operation among landowners in work of this kind. The author closes his work with a few pages on the drainage of irrigated lands and the reclamation of alkali land by underdrainage and irrigation.

Fishways and Fishponds.

FISCHWEGE UND FISCHTEICHE.—Die Arbeiten des Ingenieurs zum Nutzen der Fischerei.—By Paul Gerhardt, Councilor in the Ministry of Public Works, Berlin. Leipzig: Wilhelm Engelmann. Paper; 7 × 10½ ins.; pp. 147; 142 illustrations in the text. $2.

What consideration must be given in river and canal improvements to matters relating to fish protection, is the general subject of this work. The subject is excellently handled in thoroughness and logic of treatment as well as in style. Extended active work in this field on the part of the author gives added weight to the discussion. Roughly, half the work deals with fishways and fish-ladders, and an equal portion treats of ponds for fish cultivation. An introductory portion describes the principal varieties of brook and river fish and their habits (as far as related to the subject of the work). A concluding chapter discusses some matters not treated in the two main sections, but related thereto; matters of importance to fishery which require attention by those conducting river improvements.

The section on fishways and ladders is perhaps the most important in relation to the work of the engineer. Here we find all the various types of fishway described in proper classification: salmonways, simple passes through rapids or weirs, as well as the more complex "jumping" and "running" ways; fishways for trout and similar fish; eel-passes for old eels travelling downstream and for young eels going upstream. The discussion of required elements is very complete, the development of the various types is traced, and very many drawings of actually constructed fishways are shown and explained. Suitable dimensions and other quantities, costs of ways, etc., are also given. Most of the section deals, of course, with German, or, rather, with European practice, including many examples from the British Isles; but abundant reference is made to American work, and several specific cases are cited from practice in this country, especially the northern Atlantic coast region. The bibliography at the end of the volume contains no American title, though several Fish Commission reports are cited in the text.

CONTRIBUTIONS TO ECONOMIC GEOLOGY, 1903.—By S. F. Emmons and C. W. Hayes. Pub. doc., U. S. Geological Survey, Department of the Interior, Washington, D. C.; (Bulletin No. 225; Series A, Economic Geology). Paper; 6 × 9 ins.; pp. 527; illustrated.

This volume comprises a number of reports on individual developments of various minerals, metallic and non-metallic. Thus we find reports on different copper and gold deposits, the tin deposits of Alaska, lead and zinc in Illinois, coal in various states, etc. Of non-metallic mineral products there are the cements of Alabama, Virginia and Pennsylvania, the Nevada sulphur mines, and so on. The reports cover individual and special investigations rather than general investigations, and in some cases at least the reports appear to be rather unnecessarily diffuse, a feature which is very generally observed in Government publications.

REPORTS ON STREET RAILWAY PRACTICE.—Union Internationale de Tramways et de Chemins de Fer d'Interet Local (Street Railway and Light Railway Association). 6 Impasse du Parc, Brussels, Belgium. Paper; 8 × 13; pp. 280.

The practice of this Association in preparing reports for its meetings is to send circular letters of inquiry to the several companies represented, requesting information on the subjects selected for consideration. This information is then used as the basis of a report on each subject, prepared by a "reporter," and afterwards the specific information is published separately. The present volume contains the several replies to the list of questions relative to the subject discussed at the meeting in Vienna in September, 1903, and includes street railways in all parts of Europe. The subjects considered are as follows: 1, Funds for maintenance and renewals; 2, Regulation of tickets and transfers; 3, Brakes for electric railways; 4, Protection of trolley wires against the fall of telephone and other wires; 5, The use of trail cars on city electric railways; 6, Consumption of current; 7, Electric traction for light and local railways; 8, Current for local electric railways; 9, Track construction for local railways using steam traction; 10, Street railway legislation in European countries; 11, Accounts and monthly reports; 12, Regulation of power plants and maintenance of trolley wires; 13, Use of motor cars on railways and tramways.

MAP SHOWING THE STATIONS OCCUPIED BY THE UNITED STATES ARMY.—War Department, Office of Chief of Staff. Washington, D. C.

This large outline map shows the boundaries of the several military divisions and departments of the United States, Alaska, Porto Rico, Hawaiian and Philippine Islands. Special signs indicate division and department headquarters, stations occupied by troops, etc. In connection with this map is issued a printed list of the stations of the United States Army, with headquarters, number of regiments of cavalry, infantry, and field and coast artillery, garrisoned posts, etc.

REPORT OF THE RAILWAY AND WAREHOUSE COMMISSION OF ILLINOIS.—Pub. Doc.; two vols. Published by the Commission, Springfield, Ill. Leather; 6 × 8½ ins.; pp. 498 and 478.

The larger volume contains the report of the Commission for the year 1903, which, with the report of the Consulting Engineer and his record of interlocking plants, cover only about 60 pages. The engineer calls attention to the serious increase in number of accidents on electric railways, and he again urges the abolition of grade crossings and the use of the block system. As to the claim that the latter would reduce the capacity of the road, he shows that this is only the case if the blocks are too long. The report also points out the desirability of giving the Commission greater power of control of electric railway crossings and power to compel railways to furnish more reliable information as to railway accidents.

The remainder of the volume is taken up with statistical tables, lists of railway officers, the reports of the grain inspection department, and a number of photographs of railway bridges, stations, track elevation, work, etc., representing the work of the year.

The smaller volume contains the decisions and opinions of the Commission in cases submitted to it from 1880 to 1903.

WATER BORINGS ON THE CAPE GOVERNMENT RAILWAYS.—Pub. doc.; Railway Department, Cape Town, South Africa. Paper; 13 × 8½; pp. 63.

Owing to long continued drought, with its serious effects upon the commerce of the country and the railway revenues (through reduction in earnings and increased expense for boiler repairs), the Railway Department has been conducting a series of experiments in boring for water. There are about 12 pages of printed matter describing certain of the borings, their cost and the strata encountered. The rest of the report consists of lithographed sections of some 50 borings from 33 ft. to 1,287 ft. deep, with particulars of the size of bore, water obtained, etc.

REPORT ON THE WATER POWER OF THE ROCK RIVER AT STERLING AND ROCK FALLS, ILL.—And the Probable Effect on the Power of the Diversion of Water for Feeding the Illinois and Mississippi Canal. By Daniel W. Mead, Consulting Engineer. Chicago: Address the author, First National Bank Building. Paper; 6 × 9 ins.; pp. 72; tables, folding and other diagrams and half tones.

As this report was designed primarily for laymen it was made as untechnical as possible, and the unavoidably technical matter presented in appendixes. The total head now available at Sterling and Rock Falls in less than 9 ft. It appears that the water-power will soon be affected by the diversion of water for the Illinois and Mississippi Canal, and that Mr. Mead was employed by the Sterling Hydraulic Co. to report on the general condition of the water-power and the best means of averting damage by the proposed Government construction. The report includes statistical data and conclusions relating to the water-power in question, and recommends that the company request the U. S. Government to provide a large pondage at Sterling and to build a water-power plant for local use in connection with either an independent dam or one built in place of the present structure.

THE FLOODS OF THE SPRING OF 1903, IN THE MISSISSIPPI WATERSHED.—By H. C. Frankenfield, District Forecaster, in charge of river and flood service, U. S. Department of Agriculture, Weather Bureau. Bulletin M. Prepared under direction of Willis L. Moore, Chief U. S. Weather Bureau, Washington, D. C. Cloth; 9¼ × 11¾ ins.; pp. 63; maps and illustrations. $1.

The floods here recorded resulted from an unprecedentedly high stage of water, the greatest ever known—except in a few localities. The contents relate to and discuss the causes of this flood and the effect of artificial conditions thereon, its extent, duration, consequences and the work of the Bureau in connection with it. It is very well illustrated by maps, charts and excellent half-tone views in the flooded district.

THE NORMAL DISTRIBUTION OF CHLORINE IN THE NATURAL WATERS OF THE STATE OF NEW YORK.—By Daniel D. Jackson, Chief Chemist, Department of Water Supply, Gas and Electricity, New York City. Reprinted from the annual report of the (aforesaid) department for 1903. Paper; 6½ × 10 ins.; pp. 7; folding map.

An isochloral map of New York, Connecticut, Vermont and parts of New Hampshire and Massachusetts is the significant feature of this thin pamphlet. The chlorine, expressed in parts per 1,000,000, ranges from 16.5 on Eastern Long Island to 0.2 for Western New York and Northern Vermont.

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The Peary Arctic Club.

FIELD WORK OF THE PEARY ARCTIC CLUB, 1898-1902.—By Commander R. E. Peary, U. S. N., Bulletin of the Geographical Society of Philadelphia, Vol. IV., No. 1, Jan., 1904. Paper; 6 × 9¾ ins.; pp. 48; illustrated by a map and photographs. Philadelphia: The Society.

The Peary Arctic Club, an unincorporated association of contributors to the expedition of 1898-1902, was organized in New York, Jan. 29, 1899. The present report covers the field work for the period named, and is made interesting and valuable by a large and excellent map showing the latest data for the North Polar Region. Commander Peary tells the story of his daily experiences in a most businesslike manner, but the details appal the man who has not, like Peary, spent 16 years among the Arctic ice and all its terrors. On May 16, 1900, he reached 83° 50′ N. Lat.; and on April 21, 1902, he went out on the ice of Lincoln Sea to a point north of Cape Columbia, in 84° 17′ N. Lat. As the result of his work for the season of 1900, Peary conclusively determined the northern limit of the Greenland Archipelago, or land group, and practically mapped out the coast-line south to Independence Bay, discovered by him in 1892, and again visited in 1893-5. The only part of the periphery of Greenland still indeterminate is the comparatively short portion lying south of Independence Bay and extending to Cape Bismarck. He also settled the non-existence of land to the northward and northeastward of Greenland, at least for a very considerable distance. And he believes that every indication points to the belief that the coast travelled by him formed the shore of an uninterrupted central Polar Sea, extending to the Pole, and beyond to the Spitzbergen and Franz Josef Land groups of the opposite hemisphere. He definitely determined the point of origin of the floe-bergs and paleocrystic ice, and one result of the journey was to eliminate this route as a desirable or practicable one by which to reach the Pole. The broken character of the ice, the large amount of open water, and the comparatively rapid motion of the ice as it swung round the northern coast into the southerly setting East Greenland current were all very unfavorable features.

REPORT ON THE RAILWAYS OF THE CAPE OF GOOD HOPE.—Annual report for the year 1903. T. S. McEwen, General Manager, Cape Town. Pub. Doc. Paper; 8¼ × 13 ins.; pp. 180; map and diagrams.

This report covers the operation of the Cape Government Railways for the year 1903, and it appears that with a falling revenue and an increase in capital on account of new lines which are not expected at first to pay operating expenses, the strictest economy will be required. The new works charged to capital for the year represent about $2,208,700. In consequence of the financial depression, the grading for double-tracking of certain lines is being done as a relief work, although the labor employed is necessarily inefficient. The rail renewals include new rails of 60, 85 and 100 lbs. per yd. The drought, also, has been very serious, as in 1902, and has not only necessitated the running of water trains, but has caused heavy expense in boiler repairs due to the use of bad water. There are now 2,417 miles of railway, with about 600 miles under construction. Besides this, the Railway Department operates the 996 miles of the Rhodesian Railways.

New Publications.

REPORT OF THE ILLINOIS SOCIETY OF ENGINEERS AND SURVEYORS.—Secretary, E. E. R. Tratman, 1636 Monadnock Block, Chicago, Ill. Paper; 6 × 9 ins.; pp. 194; illustrated. 50 cts.

This volume contains the report of the proceedings of the nineteenth annual meeting of the Society, held at Champaign in January. In addition to the general proceedings, the paper and the discussions, there is a directory of the engineers and surveyors of Illinois.

The 25 or more papers deal with water-works, sewerage, irrigation, surveying, railways, pavements and other topics. In addition, a large amount of space is given to country roads and to concrete, including in the latter concrete on the farm.

PROCEEDINGS OF THE ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA.—Beardstown, Ill.: C. E. Jones, Secretary. Paper; 5½ × 8½ ins.; pp. 130.

This is the report of the twenty-first annual convention, held at Kansas City, Mo., in October, 1903. The principal reports, with their discussions, are as follows: Best method of maintaining line, surface, and gage; Improved appliances for use in maintenance of way; Track drainage and tiling; Ties, tie preservation, and tie-plates; Machine ditching; Laying 60-ft. rails at street crossings. There are also four papers: (1) Track Tools, by J. C. Rockhold; (2) General Track Work, by A. Morrison; (3) The Tie Situation in the United States, by E. E. R. Tratman; (4) Ties and Tie Timber, by H. Von Schrenk. The greater part of the technical proceedings relates to the tie question, including not only the proper use of wooden ties and the merits of different kinds of wood, but also the chemical treatment of ties, and the merits of different styles of metal and concrete ties which have been tried.

INTERURBAN ELECTRIC RAILWAYS OF INDIANA.—By Robert P. Woods, M. Am. Soc. C. E. Indianapolis, Ind.: The author. Paper; 6 × 9 ins.; pp. 14; illustrated.

This is a reprint of a paper presented at the annual meeting of the Indiana Engineering Society. In Indiana there are a number of railways of this class, many of which are noted for their length, their high speed, and other special features. The construction, electrical equipment, rolling stock and power plants are described for 22 lines, varying in length from 4½ to 163 miles and aggregating 704 miles. Maps show the location of the lines and their transmission line systems.

PIPE GALLERIES FOR NEW YORK.—By James C. Bayles. Bulletin No. 11, The Municipal Art Society of New York. New York: The Society, 37 West 31st St. Paper; 6 × 8 ins.; pp. 29; illustrated.

Much the same ground is traversed in this bulletin as was covered by the report on "Pipe Gallery Experience," made by Dr. Bayles last August and reviewed in this Journal for Oct. 15, 1903. The illustrations show the recently proposed but thwarted plans for pipe and wire subways on lower Broadway, New York City, and are printed from the blocks used in Engineering News of Jan. 7, 1904.

NORTH CAROLINA BOARD OF HEALTH.—Report for 1901 and 1902. Richard H. Lewis, Secretary. Raleigh, N. C.: The Board. Paper; 6 × 9 ins.; pp. 148; tables.

Brief descriptions of the water-works of the State are included in this report. These descriptions were prepared by Mr. J. L. Ludlow, M. Am. Soc. C. E., Winston-Salem, N. C., Engineer to the Board.

NEW JERSEY STATE SEWERAGE COMMISSION.—Boyd McLean, Secretary. Jersey City: The Commission. Paper; 6 × 9 ins.; pp. 31; folding and other plates.

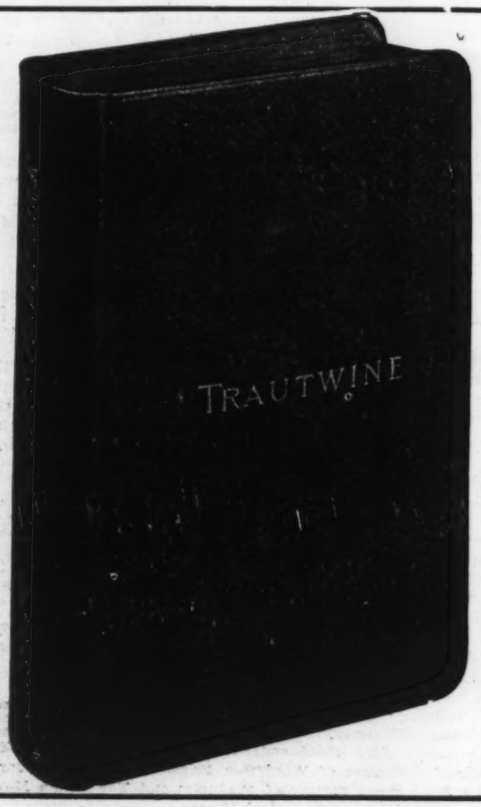
The greater part of this report is devoted to a review by the secretary of the plans for sewage disposal acted on during the year by the board, and by drawings and specifications for sewage disposal plants for country houses. Some of the plans for the septic tanks and contact beds of the borough of Collingswood, N. J., are also reproduced here. The advisability of publishing the general plans and specifications for small sewage disposal plants, accompanied by so little explanatory matter, is questionable.

CONNECTICUT STATE BOARD OF HEALTH.—Report for 1903 and Registration Report for 1902. Prof. Charles A. Lindsley, M. D., Secretary, New Haven, Conn.: The Board. Cloth; 6 × 9 ins.; pp. xxxvi. + 331 + 276; many tables.

The portions of the contents of this report most interesting to engineers are nine pages giving the results of an inspection of the eight municipal sewage treatment plants in Connecticut, by Mr. Geo. C. How, C. E., Sanitary Inspector; a description of the new water filtration plant at New Haven, by Mr. Charles A. Ferry, M. Am. Soc. C. E.; and a paper on "Filtration from the Standpoint of the Engineer," by Mr. Allen Hazen, M. Am. Soc. C. E. An abstract of Mr. Hazen's paper was printed in Engineering News of Dec. 31, 1904. All the sewage works described are of the intermittent filtration type.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—Bulletin No. 50; Secretary, L. C. Fritch, 1362 Monadnock Block, Chicago. Paper; 6 × 9 ins.; pp. 69, illustrated.

This bulletin contains a compilation of discussions of the committee reports presented at the annual meeting in March. There are also lists of the members in attendance and of the various appliances, etc., exhibited.



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Literary Magazines.

More interest than information, more imagination than reality, characterize the story of western harvesting, by C. M. Harger, in "Scribner's" for July. This, however, is true of a large proportion of stories of industries and industrial life in the popular magazines. Pictures and a picturesque style count; facts are of minor account. In another article in the same magazine Capt. A. T. Mahan, U. S. N., continues his "War of 1812" with the "Lake Frontier Campaign of 1813—to the Battle of Lake Erie."

An interesting and judicial article on "Organized Capital Challenges Organized Labor: The New Employers' Association Movement" by Ray Stannard Baker, appears in McClure's for this month. After reviewing some of these organizations, their objects and methods, Mr. Baker concludes: Both capital and labor have a right to organize. (2) In any contest between capital and labor if one side uses fair or unfair methods the other will do the same. (3) Frequent readjustments are necessary. (4) Strong disciplined organizations on both sides are desirable. (5) While organization always presumes a fighting force the prime object should be peace. (6) Which may be given in full:

> The same qualities of fair-dealing, honesty, and personal contact required in business generally are equally necessary in buying and selling labor—a transaction which is, after all, neither sentiment, nor warfare, nor speechifying, but business.

The "Review of Reviews" contains three articles that may be mentioned: In "The Triumph of National Irrigation," William E. Smythe reviews briefly but exultingly the work of construction projected and under way by the U. S. Reclamation Service. "Solving the Health Problem at Panama" by Col. Wm. C. Gorgas, Medical Corps, U. S. A., presents the subject in a hopeful spirit. Inasmuch as Colonel Gorgas will have charge of the sanitary work of the Government his outline of plans will doubtless interest many engineers. Special precautions against yellow and malarial fevers are to be taken and include, as planned, a wholesale campaign against the mosquito. "Battleships, Mines and Torpedoes," by Park Benjamin, is illustrated by half-tones and also by diagrams of mines from Fullam and Harts' "Text Book of Ordnance and Gunnery."

The most suggestive title in the "North American Review" is "The New Hell," but as on examination it proves to be theological rather than engineering in character we must pass it by with a sentence from one of the concluding paragraphs: "In short the New Hell is often made so pleasant that it is liable to be chosen by bad men as a place of residence." The direct employment of labor, with laborers, drawn from among our Southern Negroes, is suggested, in an article in the same magazine, by Brig. Gen. Peter C. Hains, as the best solution of "The Labor Problem on the Panama Canal." Following this article is a highly appreciative one by Wm. H. Blumenstein on "Arms and Ammunition in Japan."

The need of trained men as legislators and as heads of government bureaus is ably presented in "The Fortnightly Review" for June by Sidney Low in continuation of a discussion on "The Decay of Government." Mr. Low very well says:

> We require some special acquaintance with the *technique* of their work from the subordinate officials, but none from the responsible chiefs.

Although Mr. Low is writing of government in Great Britain much that he says is equally applicable here, although modifications are necessary at some points in his argument: Thus, he says, "We are satisfied if our rulers are honest, and very moderately zealous." In the United States, unfortunately, the most of the people appear to be satisfied even when their rulers are not honest, and the chief zeal demanded is often for political party rather than the public good. Other "Fortnightly" articles that may be mentioned are an anonymous one on "Japan's Object-Lesson in Naval Welfare" and "Korea; Its History and Prospects," by Sir Walter C. Hillier.

BOARD OF RAILROAD COMMISSIONERS OF THE STATE OF NEW YORK. 1903. Twenty-first annual report. Commissioners: Geo. W. Dunn, Frank M. Baker and Joseph M. Dickey. Vols. I. and II. Albany, N. Y. Cloth; 6 × 9 ins.; Vol. I., pp. 763 + 635; Vol. II., pp. 1,586; illustrations and folding map.

The first volume of this bulky report relates to the current business of the Commission, and includes the reports of inspectors, complaints, decisions and recommendations, the minutes of the board and laws relating to railways. The second volume contains the reports of railway companies for the fiscal year ending June 30, 1903, and the statistical tables compiled therefrom.

MASSACHUSETTS GAS AND ELECTRIC LIGHT COMMISSIONERS.—Report for 1902-3. Boston: The Commission. Paper; 6 × 9 ins.; pp. 204 + CXCV.; many tables.

Following the review of petitions for the reduction of rates, the increase of capital stock and the like, there appear the usual statistics relating to the municipal and private electric light and gas works throughout Massachusetts. As we have often said, this is the only publication of the kind in the United States, which fact makes so excellent a piece of work doubly valuable.

MEMORIA DE OBRAS PUBLICAS.—Correspondiente al periodo de 20 de Mayo de 1902 a 30 de Janio de 1903. Presentada al Honorable Presidente de la Republica de Cuba. Por Manuel L. Diaz, Secretario de Obras Publicas. Habana: 1904. Paper; 6¼ × 9¾ ins.; pp, 529; maps and illustrations.

This Memorial of the Secretary of Public Works of Cuba to the President of the Republic includes the separate reports of the Chief Engineer of Havana and the Chief Engineer of Districts. These reports are in detail, and are fully illustrated by maps and many half-tones showing engineering works.

MAPS OF S N PAULO.—A series of completed and progress maps made under the direction of the Geographical and Geological Commission of the State of San Paulo, S. A. Orville A. Derby, Chief; Horace E. Williams, Chief of the Topographical Department.

These thirteen maps, with the inscriptions in Spanish, give the detailed topography of nearly the whole of the central portion of this state, commencing with the coast line near S. Paulo.

FIRST ANNUAL REPORT OF THE CHARLES RIVER BASIN COMMISSION, Oct. 1, 1903. Boston: State Printers. Paper; 6 × 9 ins.; pp. 20.

This is a progress report of the commission appointed in 1903 to construct a dam across the Charles River, between the cities of Boston and Cambridge; Hiram A. Miller, M. Am. Soc. C. E., is the Chief Engineer.

RECEIPTS AND EXPENDITURES OF ORDINARY REVENUE, 1898-1902. Special Publication No. 9, Statistics Department, City of Boston, Mass. Boston: City Doc. Paper; 9½ × 12 ins.; pp. 159; tables.

The ordinary receipts and expenses of the city of Boston for the past six years are here presented in an admirable form, which should be of great value to the citizens of Boston, and might well stimulate other cities to a like presentation of classified comparative financial statements.

PLEASURE DRIVEWAY AND PARK DISTRICT OF SPRINGFIELD, ILL.—Second Annual Report of the Board of Trustees. Springfield, Ill. Paper; 7 × 10 ins.; pp. 71; illustrated.

Aside from the comprehensive report upon the engineering work performed and the detail of the work of the board, this publication is especially notable for its excellent and artistic photographic illustrations of scenes in and about its driveway and parks.

ROAD IMPROVEMENT BULLETINS.—Department of Agriculture, Office of Public Road Enquiries. Washington, D. C.: Pub. doc. Paper; 6 × 9 ins.; pp. 8 and 10; illustrated.

These are reprints from the "Year Book" of the Department for 1903. The first is on "Building Sand-Clay Roads in Southern States, "by W. L. Spoon; the other is on "The Progress of Road Building in the Middle West," by R. W. Richardson.

BULLETIN OF THE BUREAU OF LABOR.—Department of Commerce and Labor, No. 51. March, 1904. Washington, D. C. Paper; 6 × 9 ins.; pp. 219-484; diagrams.

The chief contents of this bulletin are—The Course of Wholesale Prices for 1890-1903, for a great variety of products; and The Union Movement among Coal-Miners.

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REFUSE DISPOSAL AND POWER PRODUCTION.—By W. Francis Goodrich, Assoc. Inst. M. E. New York: E. P. Dutton & Co. Cloth; 6 × 8½ ins.; pp. 384; tables and 98 illustrations. $3 net.

GEOLOGIC ATLAS OF THE UNITED STATES.—No. 101: San Luis Folio, California. No. 109: Cottonwood Falls Folio, Kansas. Washington, D. C.: Pub. Doc.

CROSS-TIE FORMS AND RAIL FASTENINGS, with Special Reference to Treated Timbers.—By Herman Von Schrenk, in charge of Forest Products. Bureau of Forestry, U. S. Department of Agriculture. Washington, D. C.: Pub. Doc. Paper; 6 × 9 ins.; pp. 70; illustrated.

GEOLOGICAL SURVEY OF OHIO.—Edward Orton, Jr., State Geologist. Fourth Series. Bulletin No. 1. The Occurrences and Exploitation of Petroleum and Natural Gas in Ohio. By John Adams Bownocker, D. Sc., Professor of Inorganic Geology, Ohio State University. Columbus, O.: Pub. Doc. Cloth; 6½ × 9½ ins.; pp. 325; illustrations and maps.

THE STATISTICAL YEAR-BOOK OF CANADA FOR 1903.—Nineteenth year of issue. Ottawa, Ont.: Department of Agriculture. Paper; 6 × 9 ins.; pp. 773.

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